Diesel Power

& Diesel Transportation

Diesels in the Construction Industry

Our 28th Year

OCTOBER, 1950

KEEP ENGINES . . . CUT COSTS

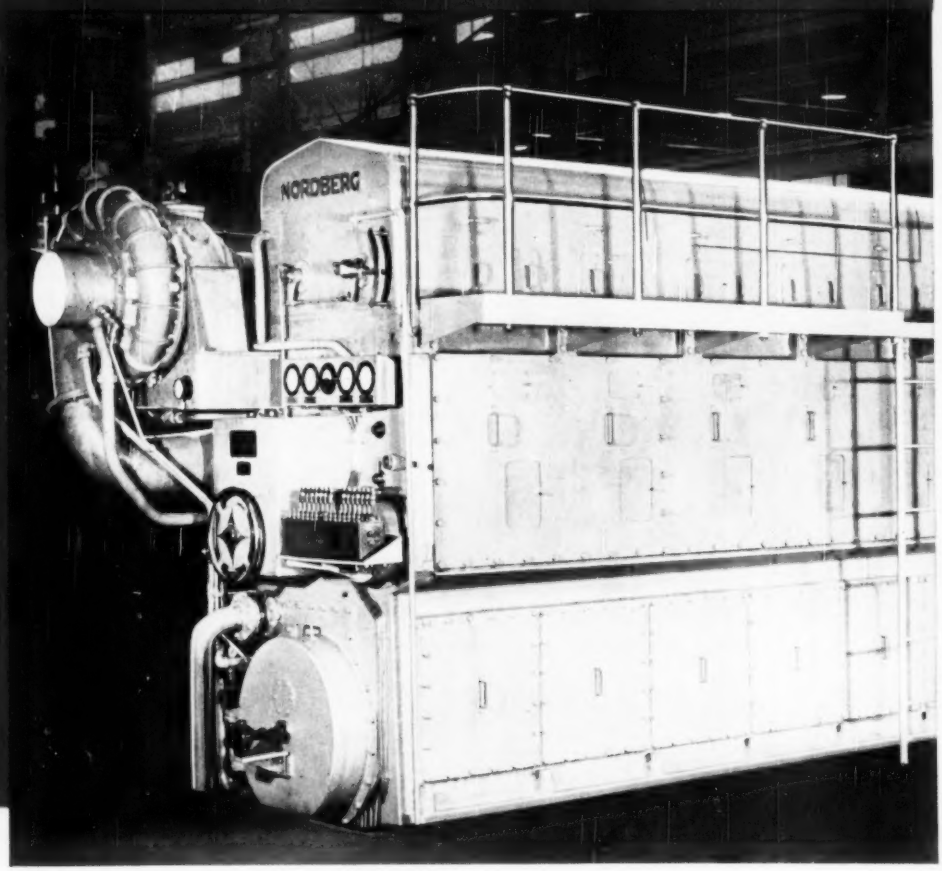


Photo courtesy Nordberg Mfg. Co.

TUNE IN . . .
TEXACO STAR THEATER
starring MILTON BERLE
on television
every Tuesday night.
See newspaper for
time and station.

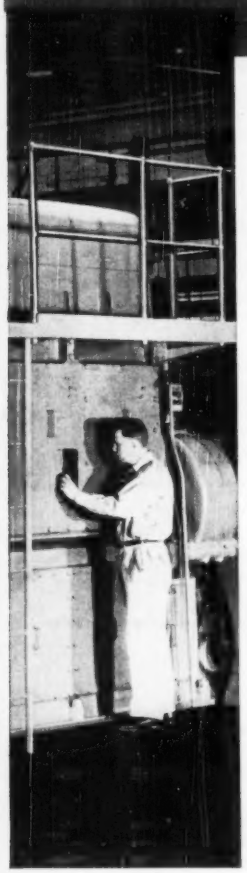
TEXACO
REG. T.M.

TEXACO

DIESEL POWER and DIESEL TRANSPORTATION for October, 1950, Vol. XXVIII, No. 10. It is published monthly by Diesel Publications, Inc., Orange, Conn. Executive and Editorial offices 136 Lexington Ave., New York 16, N. Y. Subscription rates: United States, $3.00 per year, single copies 35¢. Canada $4.00. Foreign, $5.00 per year. Entered as second class matter April 28, 1949 at the Post Office, Orange, Connecticut, under Act of March 3, 1879.

CLEAN

Maintenance costs and fuel consumption come down when you lubricate with TEXACO URSA OILS



Engines—whether Diesel, gas or dual-fuel, large or small—all run cleaner when lubricated with *Texaco Ursa Oils.* That means more trouble-free operation . . . better compression and combustion . . . less fuel used . . . less maintenance expense.

Texaco Ursa Oils have exceptional resistance to oxidation. They keep harmful carbon and sludge from forming and keep rings free for proper seal. They also protect bearings from corrosion, reduce wear, and extend the life of all moving parts.

Leading engine builders approve *Texaco Ursa Oils* and operators everywhere prefer them. For instance, in the Diesel field —

More stationary Diesel h.p. in the U. S. is lubricated with Texaco Ursa Oils than any other brand.

Step up the efficiency of your engines and reduce your operating costs. A Texaco Lubrication Engineer will gladly help you. Just call the nearest of the more than 2,000 Texaco Wholesale Distributing Plants in the 48 States, or write The Texas Company, 135 E. 42nd St., New York 17, N. Y.

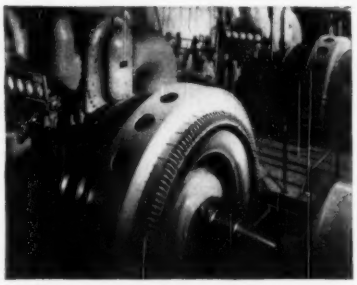
URSA OILS FOR ALL DIESEL, GAS AND DUAL-FUEL ENGINES

AT YOUR SERVICE: *50 years*

High-quality generators at minimum cost . . . the natural result of 50 years of G-E generator-building experience

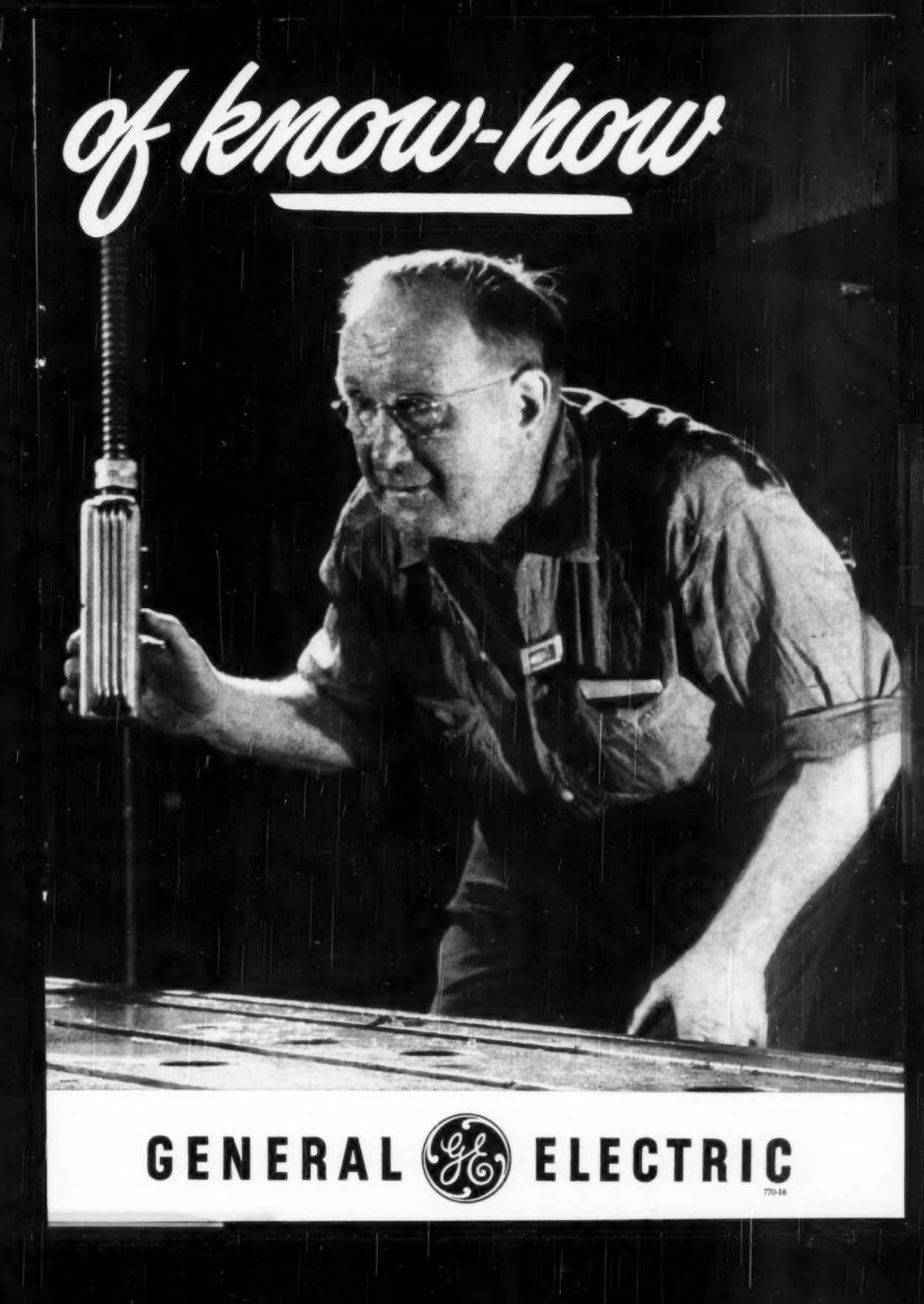
Quality that gives you the most for your generator dollar is the natural result of more than half a century of generator building . . . the result of skills developed by men like Charles Wahl.

A machinist for more than 40 years, Mr. Wahl learned his high standard of workmanship from men like his father, also a master machinist. Today he's passing his tradition of craftsmanship along to younger men . . . teaching them to build G-E quality into electric equipment. We're proud of Charles Wahl, and Mr. Wahl is proud to help us give you the service that's your right as a G-E customer.



Dependability and high operating efficiency are characteristic of every G-E synchronous generator . . . the result of more than 50 years' experience in development, manufacture, and application of synchronous generators. Performance records of thousands of these sturdy, efficient generators now on the job have made G.E. a "buy" word for purchasers of power-generation equipment. Apparatus Department, General Electric Co., Schenectady 5, N. Y.

Your Best Generator Buy...


of know-how
GENERAL ELECTRIC
770-16

An International UD-24 Diesel Powers Road Rock Crusher

A portable rock crushing plant furnishing crushed stone to road builders improving a state highway delivers 100 yards per hour, powered by an International UD-24 Diesel power unit. Like crushing plants everywhere, it depends on durable power to pay off in profitable work.

In the stone crushing industry International diesels mean dependable and economical power. The reasons why are clear. Internationals squeeze the last bit of power out of every ounce of fuel. Their rugged construction and superb sealing allow them to work in the clouds of dust so common to quarry and crushing operations. You just can't beat an International diesel for long, productive life on jobs like these. Hour after hour, day after day, month after month, International diesels pay real operating dividends.

A visit to your International Industrial Power Distributor or Power Unit Dealer will show you all the reasons why International diesels are ideal power. Let your distributor show you the features which produce the power and dependability you need to make your plants pay more profits.

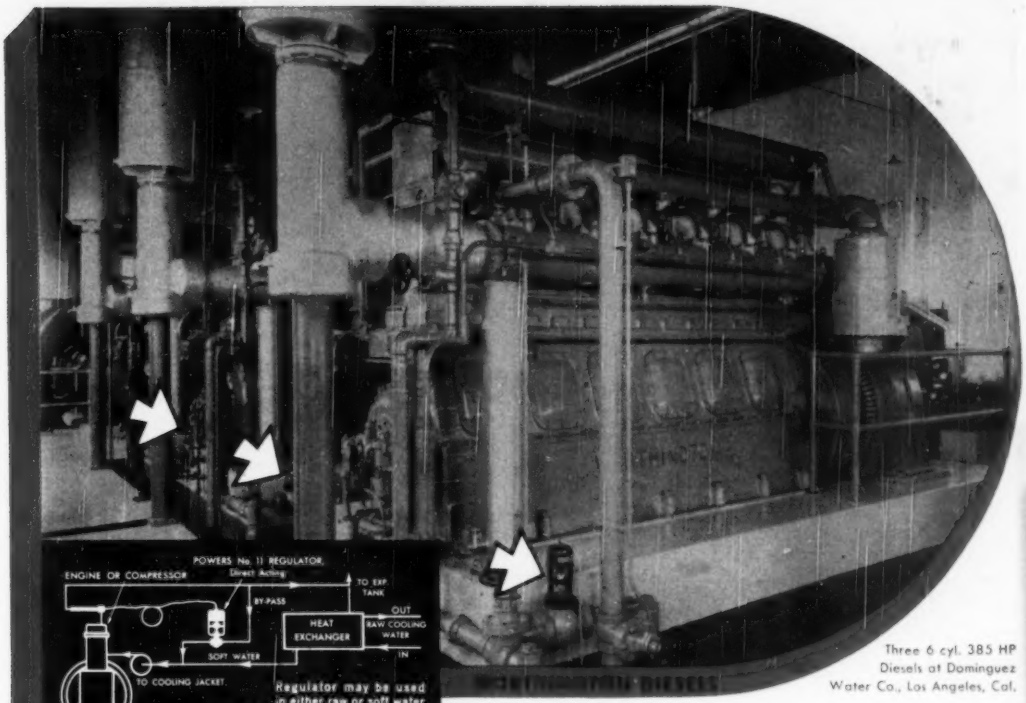
INTERNATIONAL HARVESTER COMPANY
Chicago

Standardize on Power that Pays

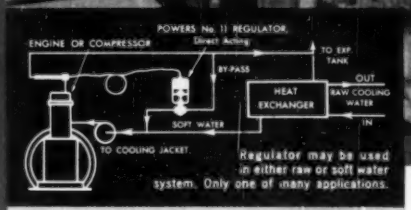
INTERNATIONAL HARVESTER

INTERNATIONAL INDUSTRIAL POWER

CRAWLER TRACTORS • WHEEL TRACTORS • DIESEL ENGINES • POWER UNITS



Three 6 cyl. 385 HP Diesels at Dominguez Water Co., Los Angeles, Cal.



Regulator may be used in either raw or soft water system. Only one of many applications.

Powers No. 11 Self-Operating Temperature Regulator for jacket water or lube oil control. Available direct or reverse acting, or 3-way valve. Sizes ¼" thru 2" have bronze double union valves; sizes 2½" thru 8" have flanged iron bodies. Pneumatic controls also available.

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TEMPERATURE CONTROL

End Danger of Cracking Pistons, Cylinder Heads and Sludging, with POWERS Thermostatic Control

Regulate jacket water and lube oil temperatures automatically with POWERS control. Regardless of load or seasonal changes Powers Regulators hold the temperature just where you want it. They prevent *over*heating and *over*cooling.

Accurate Temperature Control—insures better lubrication, longer cylinder liner wear, fewer piston ring replacements, prevents danger of piston seizure, reduces fuel and lube oil consumption.

Powers Control Costs Less than a set of new piston rings. Often pays back its cost the first year. It's economical, reliable, gives many years of dependable service.

Have a Powers Engineer Call to study your requirements for better temperature control. With both *self-operated* and *pneumatic controls* plus many years of experience we may be able to help you select the type that will give best results. There's no obligation. THE POWERS REGULATOR CO., *Established 1891 • Offices in Over 50 Cities • See Your Phone Book.*

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(D-11A)

The Powers Regulator Co., 2710 Greenview Ave., Chicago 14, Illinois

Have engineer call to study our requirements for better jacket water temperature control.

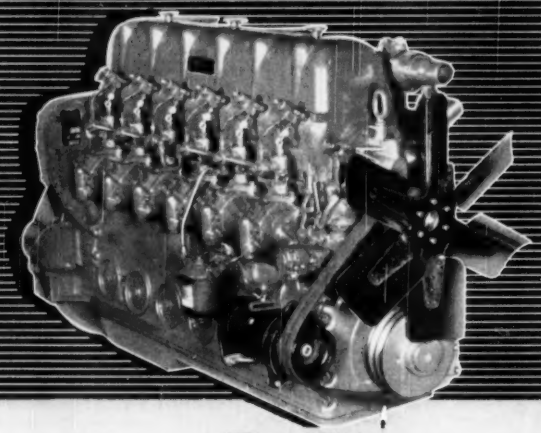
Name of Engine or Compressor ..... HP .....

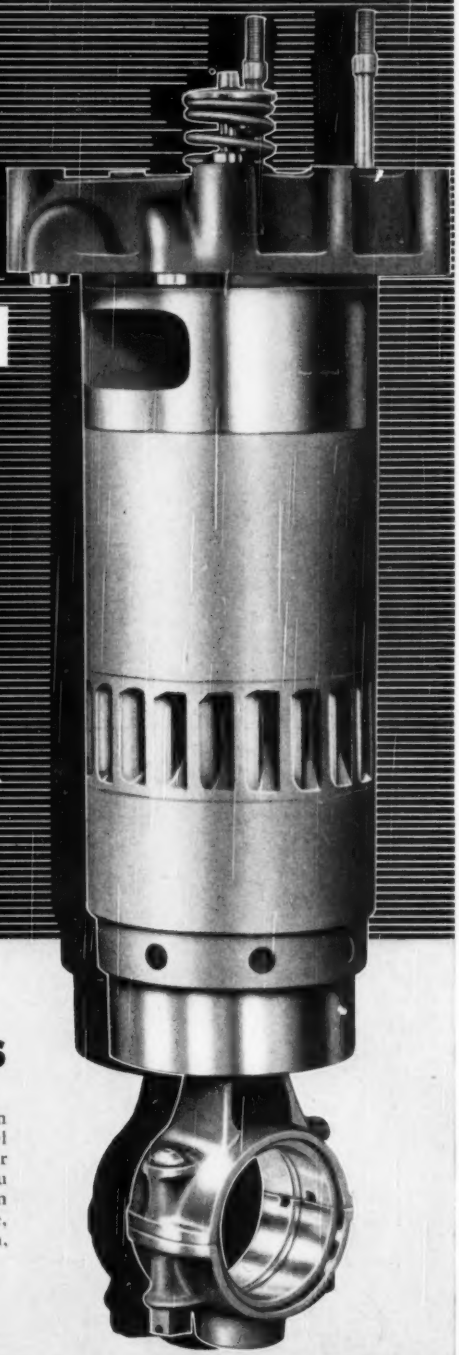
Your Name .....

Address .....

City ..... State .....

simplified design





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DIESEL ENGINES
(2 Cycle)

The complete assembly of cylinder head, liner, piston and rod is interchangeable as a unit in *all* P&H Diesel engines — 1, 2, 3, 4 or 6-cylinder models. Simpler design with fewer parts saves you time — saves you trouble — saves you money. It's another good reason for standardizing on P&H Diesels. For literature, write Diesel Division, Harnischfeger Corporation, Port Washington, Wisconsin.

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Today, it is essential to use the best lubricants money can buy — for maximum efficiency . . . lowest operating cost. That's why more and more production machinery is being lubricated with Tycol oils and greases.

Whatever your lubricating need — for turbine, steam engine, mine car or tipple, textile mill, stationary Diesel or locomotive — there's a Tycol high quality oil or grease exactly suited to your specific need.

In developing this comprehensive line, Tycol subjects each individual oil and grease to rigid tests during manufacture. This control assures the required lubrication characteristics — *POUR POINT, viscosity, color, penetration, to name a few — for maximum performance of that particular product.

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This informative handbook, "Tide Water Associated Lubricania," gives clear, concise descriptions of the basic tests used to determine important properties of oils and greases. For your free copy, write to Tide Water Associated Oil Company, 17 Battery Place, New York 4, N. Y.

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To engine builders . . . and manufacturers of Diesel-powered equipment . . . and users of Diesel engines . . . this means: When an Exide does the cranking, your engines START.

You can count on a *quick breakaway, high cranking speeds, low voltage drop.*

You can count on trouble-free performance . . . in rugged service . . . in all climates.

You can count on long battery life and low cost maintenance . . . proved daily in buses, trucks, trailer tractors, off-the-highway equipment, ships, power plants, Diesel-electric locomotives.

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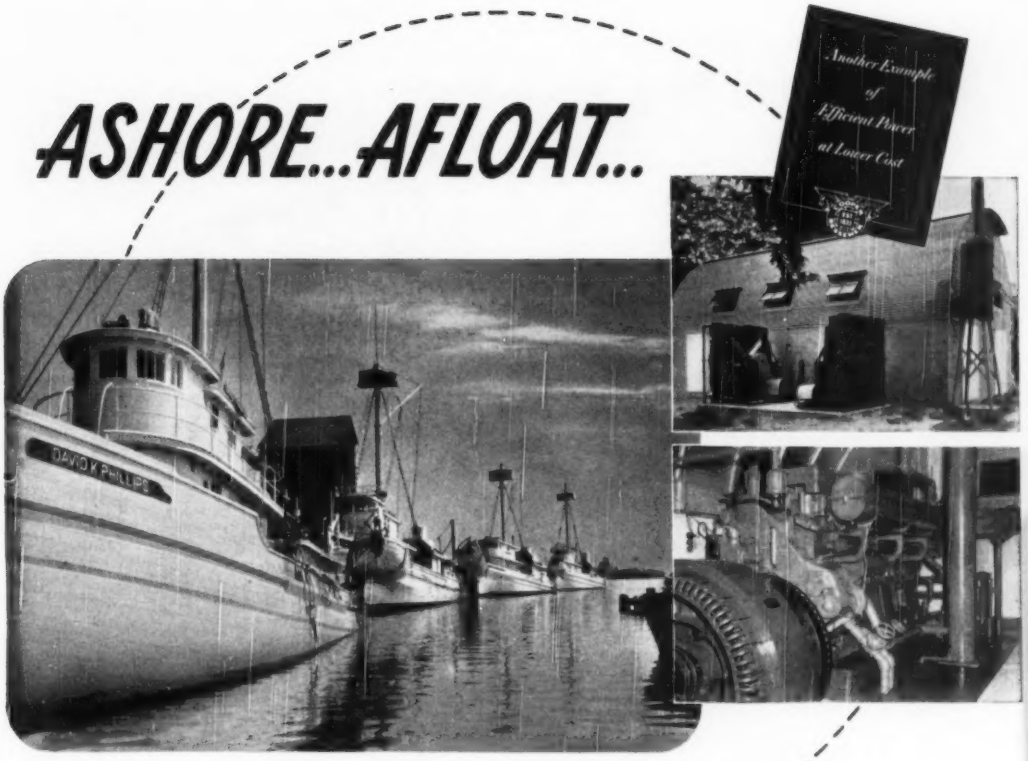
ASHORE...AFLOAT...



it's Cooper-Bessemer 100%

for 2-way savings at Reedville Oil & Guano Co.

This company's fish reduction plant, where 50 tons of Menhaden can be processed per hour, is now completely powered by its own diesel-electric power plant. The prime mover is a Cooper-Bessemer diesel, preferred largely because of the outstanding performance of Cooper-Bessemer marine diesels in the company's four large Menhaden boats shown above.

The fact that each of these boats was converted from steam to Cooper-Bessemer diesel propulsion over a period of years speaks for itself—evidences the high efficiency and over-all operating economy of these lusty engines. Similarly, the stationary Cooper-Bessemer in shore service will soon pay for itself in reduced power costs.

For low-cost diesel power at its best, stationary, marine or locomotive, you'll be wise to check with Cooper-Bessemer.

Above, left: "David K. Phillips", "Margaret", "Alden S. Swan" and "William J. Brustar", 125' to 130' over-all, all repowered from 1944 to 1947 with Cooper-Bessemer direct-reversing diesels ranging from 515 to 730 bhp.

Above, right: Exterior and interior view of diesel-electric plant, powered by a supercharged Cooper-Bessemer 865 hp JS-6 diesel driving a 600 kw Elliot generator. Radiators adjacent to power house cool engine jacket water and water for lube oil cooler.

The
Cooper-Bessemer
Corporation
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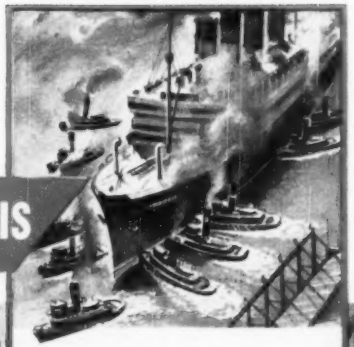
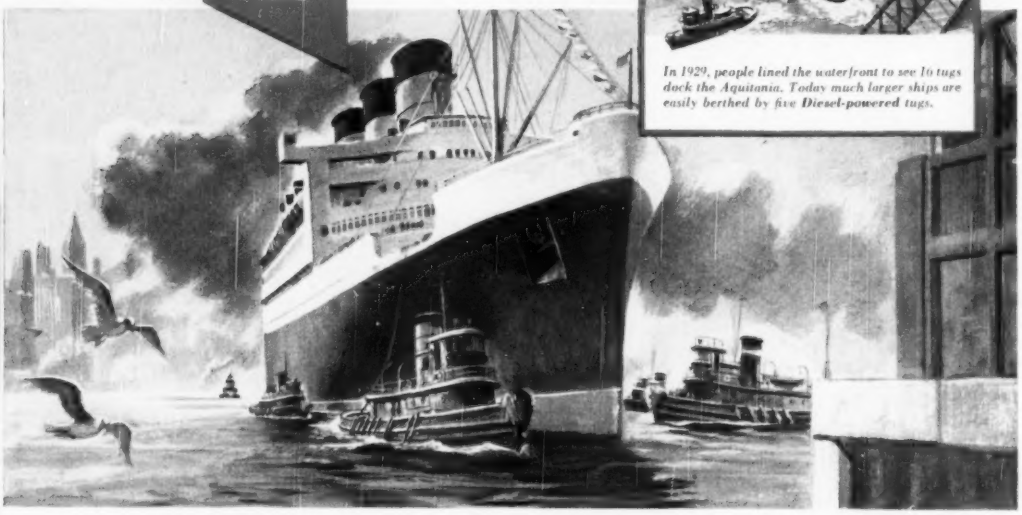
Caracas, Venezuela Gloucester, Mass. Calmes Engineering Co., New Orleans, La.

What important thing was necessary to change THIS to THIS



In 1929, people lined the waterfront to see 16 tugs dock the Aquitania. Today much larger ships are easily berthed by five Diesel-powered tugs.



1. *Development and Field Engineering.* American Bosch engineering departments and laboratories work constantly to improve existing products, develop new ones such as the revolutionary single plunger multi-cylinder PSB Pump. Our field engineers work hand in hand with engine and equipment manufacturers — from original design to test models and actual field operation.

2. *Precision Manufacture.* The knowledge and craftsmanship that made solid fuel injection a reality . . . plus engineering research, proven techniques, unparalleled production and testing facilities (many of them initiated and developed here) . . . insure uniform adherence to the highest standards of accuracy and performance.

3. *Service Organization.* In many U.S. cities and at strategic points throughout the world, American Bosch maintains an ever-growing network of authorized service stations. Staffed by personnel trained to factory standards, with factory-designed and built testing equipment, they are prepared to render efficient and reliable service whenever needed.

Dependable Fuel Injection

Many things — and many men — have contributed to the progress of Diesel power. But one vital element necessary to make this efficient, economical source of power universally applicable was dependable solid fuel injection.

American Bosch was a pioneer and still is a leader, in this field . . . a position established and maintained by American Bosch development and field engineering, precision manufacture and its ever-expanding network of service agencies.

You can depend on premium performance when the fuel injection system bears the name American Bosch.

American Bosch

Dependable Fuel Injection for the Diesel Industry

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Alnor Protection

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To assure continued high efficiency, every diesel should have the best protection against maladjustment and wear. Alnor Exhaust Pyrometers provide this protection by giving an instant check on all cylinders, anticipating trouble from preignition, detonation, overloading, or breakdown of lubrication, etc. Modern design and rugged construction assure accurate, reliable instrument service on any installation, large or small, even under severe operating conditions.

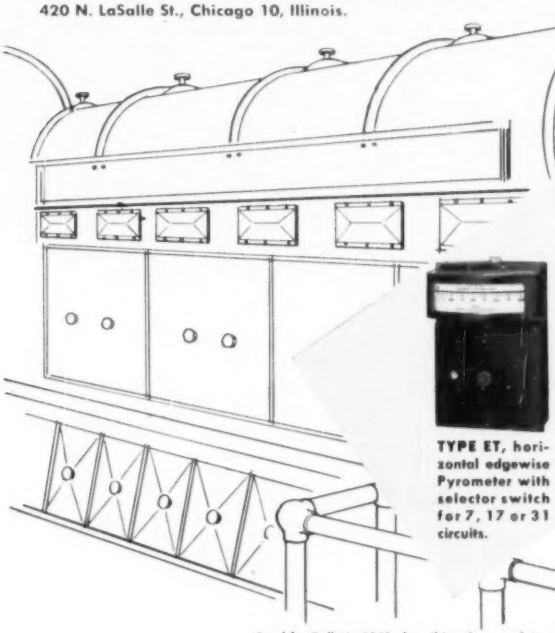
Such constant protection reduces maintenance time and expense to a minimum—increases efficiency and operating economy. Alnor Pyrometers are low cost, easy to install on old or new engines. Ask your Alnor Representative to assist you in selecting the right equipment from the full line of Alnor Exhaust Pyrometers and special thermocouples. Illinois Testing Laboratories, Inc., Room 507, 420 N. LaSalle St., Chicago 10, Illinois.

TYPE RT, switchboard type flush or surface mounting with switch for 8, 17 or 31 circuits.

TYPE BZ, for switchboard, wall or bracket mounting, with switch for 8 or 17 circuits.

TYPE FAX, for switchboard or flush mounting, with switch for two to 16 circuits.

TYPE ET, horizontal edgewise Pyrometer with selector switch for 7, 17 or 31 circuits.



Send for Bulletin 4361, describing the complete Pyrometer line. Use this handy coupon.

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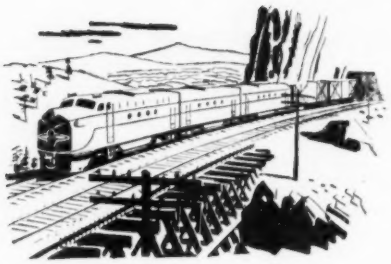
PRECISION INSTRUMENTS FOR EVERY INDUSTRY



Fuel cost on freight trains reduced 58%

Between July 1949 and the end of the year, the Chicago and North Western Railway increased its fleet of General Motors Diesel locomotives from 47 to 107 units. This new equipment made it possible for the railroad to handle 60.7% of its freight gross ton-miles with Diesel power.

Fuel cost on these Diesel units was 14 cents per 1,000 gross ton-miles as compared with 31.2 cents on steam locomotives handling the balance of freight operations—*a saving of 58% in favor of GM Diesels!*

The North Western has since added 30 more GM Diesel units which will enable the carrier to haul a still larger percentage of its freight at reduced fuel cost.

Fuel economy is only one reason why so many railroads are dieselizing more and more of their freight, passenger and switching operations. Greater dependability, lower maintenance, more economical parts replacement—all help offset other rapidly increasing railroad costs.

Strong solvent railroads in the hands of competitive industry are essential to America's prosperity and growth. Fifteen years' experience has demonstrated that dieselization with General Motors locomotives is the soundest investment a railroad can make.

GM
GENERAL MOTORS
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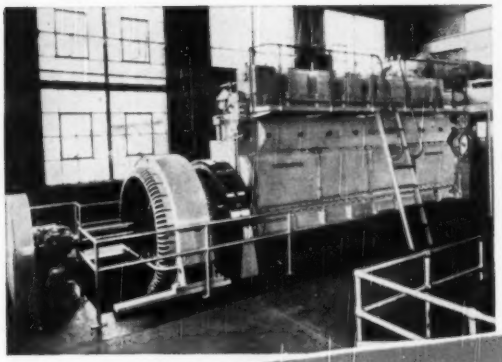
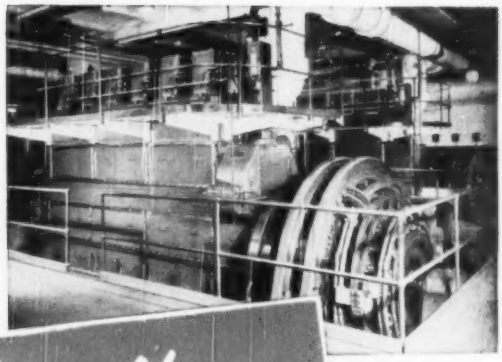
A Green Light for Economy in Railroad Operation

ELECTRO-MOTIVE DIVISION

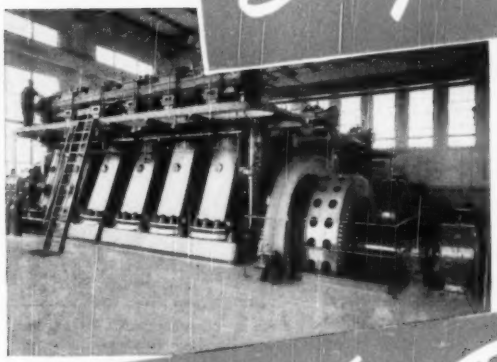
GENERAL MOTORS • LA GRANGE, ILLINOIS

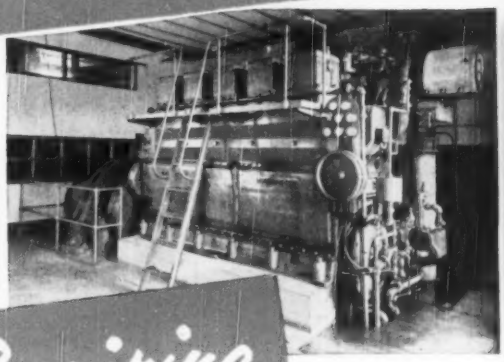
Home of the Diesel Locomotive





Every One New...





Every One Requiring

ADVANCED LUBRICANTS

DIESEL UNITS like these new "big babies" are a vitally important investment to any plant. They deserve and demand only the finest lubrication. Start them off with the right type and grade of oil and they will operate efficiently with little maintenance expense.

Take full advantage of the knowledge and experience of the Cities Service Lubrication specialists. These men are fully informed on the lubrication requirements of all the latest models. Their advice and recommendations can contribute to longer years of use, dependable and economical performance.

Write Cities Service Oil Company, Room 715, Sixty Wall Tower, New York 5, New York.

HELPFUL NEW BOOKLET—FREE!

We have a new 64 page manual entitled "Diesel Engine Lubrication." Write for your free copy of this fact-filled lubrication guide today.

CITIES SERVICE

Now available . . . New "Caterpillar" Diesel DW20 wheel type tractor and W20 wagon. Capacity: 25 cu. yards earth. Power is protected with Purolator Oil Filters.

When the job is earth-moving . . .

No matter what you do . . . as long as the job has to do with earth, engines are bound to suck in abrasive-laden dirt.

Unless you remove this destructive load from the oil stream—you're in for expensive repairs, for costly lay-up time.

Here—as under any other rugged operating condition—you can rely on a Purolator* Micronic Oil Filter.

Purolator's exclusive Micronic* element traps abrasives measured in microns (.000039 of an inch) . . . has a revolutionary accordion-pleated design which provides a filtering area as much as 10 times that of old-style oil filters. What's more, it does not remove the important additives.

For lube oil, Purolator's more efficient filtration assures less wear on hard-working bearings and other vital engine parts.

For fuel oil, it means the complete job so vital because of close tolerances of injector plungers and parts.

We know that Purolator can solve your filtering problem. Let our engineering staff show you how!

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Protect your Power with Purolator!

*Reg. U. S. Pat. Off.

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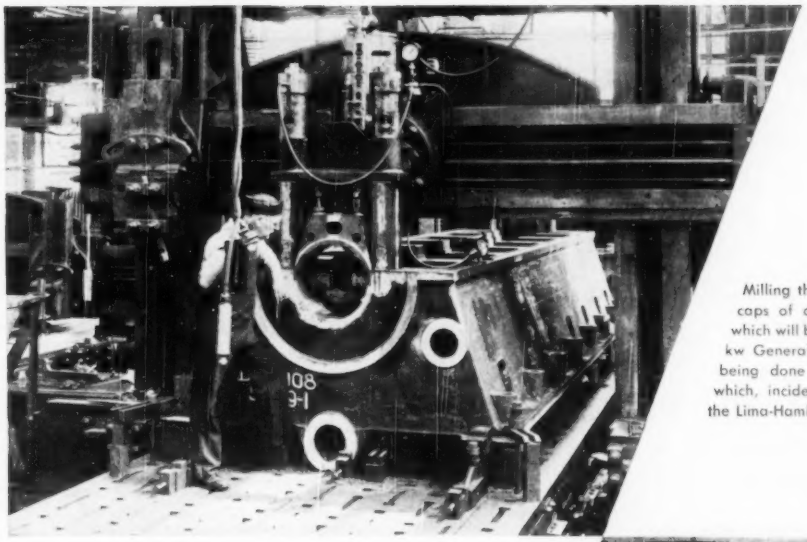
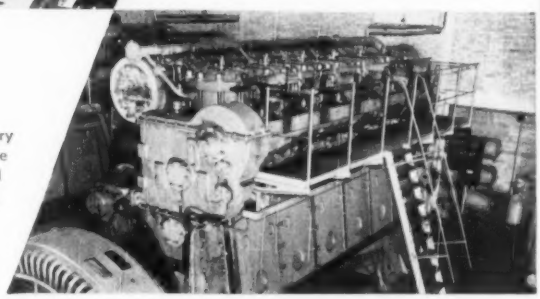
MICRONIC OIL FILTER
"FIRST IN THE FIELD OF FILTERING"



Milling the main bearing saddles and caps of a 6-cylinder Hamilton diesel which will be direct-connected to a 2000-kw General Electric generator. Work is being done on a Niles 10-foot planer which, incidentally, is also a product of the Lima-Hamilton Corporation.



The Anaconda diesel, when installed, will look very much like this 6-cylinder 2250-hp Hamilton engine at Harwood, N. D. The generator, however, will be d-c to supply power for electrolytic refining of copper.

How perfect bearing alignment is achieved on

HAMILTON DIESELS

This casting, approximately 22 feet long and weighing 20 tons, is the bed plate of a Hamilton diesel being built for Anaconda Copper Mining Company. It will be delivered late this fall, to power a General Electric 2000-kw, 250-volt, 250-rpm direct-current generator.

The significance of the photograph is this: It shows how perfect bearing alignment is achieved on Hamilton diesels.

The bed plate is completely planed. Then a milling head is mounted on the cross rail of the planer, and without disturbing the setting of the bed plate, the bearing shell saddles are milled. This is done with the caps in place — *under exactly the same conditions which prevail when the engine is operated.* Thus perfect alignment is obtained.

Such precision in manufacture pays off in lower maintenance for the user.

* * *

Hamilton diesels, with 21½ inch bore and 27½ inch stroke, are available with 5 to 12 cylinders. Ratings are 482½ bhp (net) per cylinder as a straight diesel and 455 bhp per cylinder as a dual fuel engine, both at 257 rpm. For full information, call the Lima-Hamilton Sales Offices in New York or Chicago, representatives in other cities, or write directly to Lima-Hamilton Corporation, Hamilton, Ohio.

LIMA HAMILTON CORPORATION

HOOVEN, OWENS, RENTSCHLER CO. **HAMILTON, OHIO**

a division of the Lima-Hamilton Corporation

DIESEL-ELECTRIC LOCOMOTIVE

BY C. F. FOELL
AND M. E. THOMPSON

THE BOOK FOR THE "AGE OF DIESEL" IN RAILROADING

658 PAGES—560 ILLUSTRATIONS

Yes, the trend today is to Diesel in the railroad field. And with this extraordinary volume on the DIESEL-ELECTRIC LOCOMOTIVE, you have the most up-to-date and comprehensive treatment of this field that is obtainable.

Here you'll find the railroad Diesel from A to Z; its history, advantages, engineering, construction, operation, principles of maintenance and selection to meet varying conditions of expected use. It is a basic handbook designed to answer every conceivable problem. At the same time, it is keyed to the practical conditions of operation, and discusses and presents all the specific types of engines.

Railroad officials call this the most genuinely useful book on Diesel railroading they have seen. It is an invaluable guide that enables you to have at your side, at very low cost, the answers to every question that may arise to puzzle you.

TABLE OF CONTENTS

History and Development—Advantages—Classes of Locomotives:—Construction and Parts—The Engine-Generator Assembly—Traction Motors and Final Drive—Propulsion Control, Main and Accessory—Power Plant Controls—Locomotive Selection—The Diesel Cycle—Diesel Engines, Types and Styles—Locomotive Diesel Engines—Fuels and Combustion—Fuel Systems, Jerk Pump Types, Distributor and Common-Rail Types—Lubricants and Lubrication—Major Locomotive Accessories—Trucks, Brakes—Mechanical and Hydraulic Drive Diesel Locomotives—Engineering Fundamentals, Mechanical, Magnetic and Electrical—Maintenance of Engine, Generators, Motors, Auxiliary Electric and Mechanical Items.—Notes on Operation and Maintenance.

DIESEL PUBLICATIONS, INC.
192 Lexington Avenue, New York 16, N. Y.

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Company .....

Occupation .....

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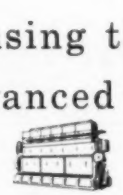
$5.00

Are YOU using the FILTER that advanced Filtration as much as the DIESEL advanced the internal combustion engine?



WHICH

is the only micronic filter that works by a positive mechanical principle?

Cuno MICRO-KLEAN consists of a cartridge of fibres distributed under scientific control. It positively removes all injurious solids from Diesel fuel. Resinous-impregnated cartridge, unaffected by moisture, etc., won't soften, swell, harden, rupture or release contaminants to clog injectors or damage pump. (MICRO-KLEAN can be installed on suction side of pump.)

Diesel users will like . . .

Longer life—Exclusive "graded density in depth" permits smaller particles to penetrate to varying depths—doubles dirt-holding capacity.

No Channeling—Resinous impregnation and polymerization prevents channeling, rupturing, etc.

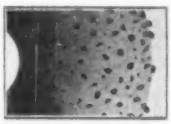
Low pressure drop

No removal of additives from lube

No danger of cartridge failure—Impervious to crankcase acids, moisture, other damaging agents.

WHICH FILTER needs the least amount of room?

Cuno MICRO-KLEAN cartridge is utterly simple. It's *all* filter—no structural components. This means less space needed—and makes *full-flow filtration* of lube oil a practical possibility.



WHICH FILTER is guaranteed for specific performance?

Felting of fibres is accurately controlled for various densities . . . so that a Cuno MICRO-KLEAN of a given density will positively remove 100% of all solids for which it is rated, plus a large percentage down to 1 micron.

NO FLUID IS BETTER THAN ITS FILTRATION

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Removes More Sizes of Solids from More Types of Fluids

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Company .....

Address .....

City ..... State .....

PLEASE ATTACH COUPON TO YOUR BUSINESS LETTERHEAD

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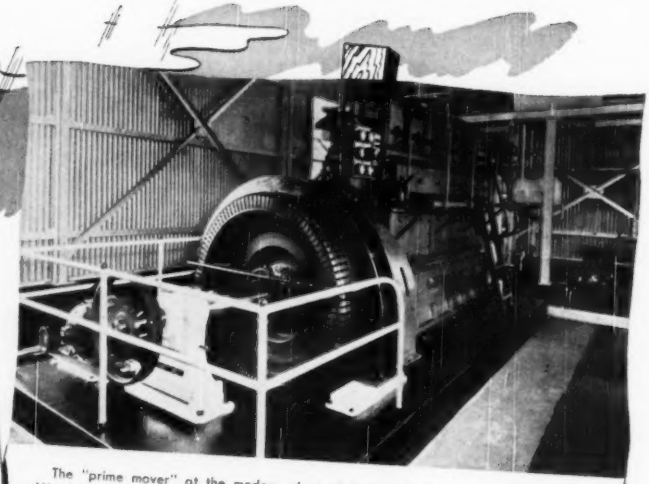
. . . on the Bonneville Salt Flats . . . it's

DIESEL

performance!



The "prime mover" at the modern plant of Bonneville, Ltd., Wendover, Utah. A Worthington Supercharged Diesel Engine, Type SCC-6. Worthington auxiliaries are used for the water cooling system.

Worthington Engine Outstanding For Economy and Dependability Under Difficult Conditions

Organized in 1935, Bonneville, Ltd., is a primary source of commercial potash, producing 70,000 tons annually from the evaporating ponds in the Wendover, Utah, Salt Flats area. This remote site of the world's automobile speed records is far from public utility plants, even from adequate fresh water supply. Power, therefore, is a problem.

Management found the solution in a Worthington Supercharged Diesel, Type SCC-6, rated 489 hp at 4,250 ft elevation.

Replacing several small, high speed Diesels, the new Worthington unit is the sole electrical generating source in a set-up designed by Worthington engineers to deliver maximum power from the fuel consumed, and to operate with a cooling system requiring a minimum of make-up water.

For The Record

The Bonneville Worthington has lived up to every expectation for efficient, cost-cutting performance. *Consumption of fuel oil is at the rate of 14.25 kw hours per gallon at this altitude. Also, over 73% of the low-cost fuel oil is put to useful work — utilization of heat from the exhaust and from the cooling system (high-temperature type) being a main factor in achieving this high percentage.*

To a broad range of ratings including every type of heavy duty Diesel and gas engine, Worthington adds outstanding engineering knowledge and a rich background of experience — and technical assistance to help you get the most out of your own power planning. For further details of the dependable, economical Diesel performance that proves *there's more worth in Worthington*, contact *Worthington Pump and Machinery Corporation, Engine Division, Buffalo, New York.*

WORTHINGTON

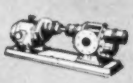
E.O.6

YOUR PARTNER IN POWER PROGRESS

WORTHINGTON-BUILT AUXILIARIES

Diesel engines, 150 to 3,520 hp . . . gas engines, 175 to 3,520 hp . . . dual fuel engines, 225 to 3,290 hp.

Balanced Angle Compressors



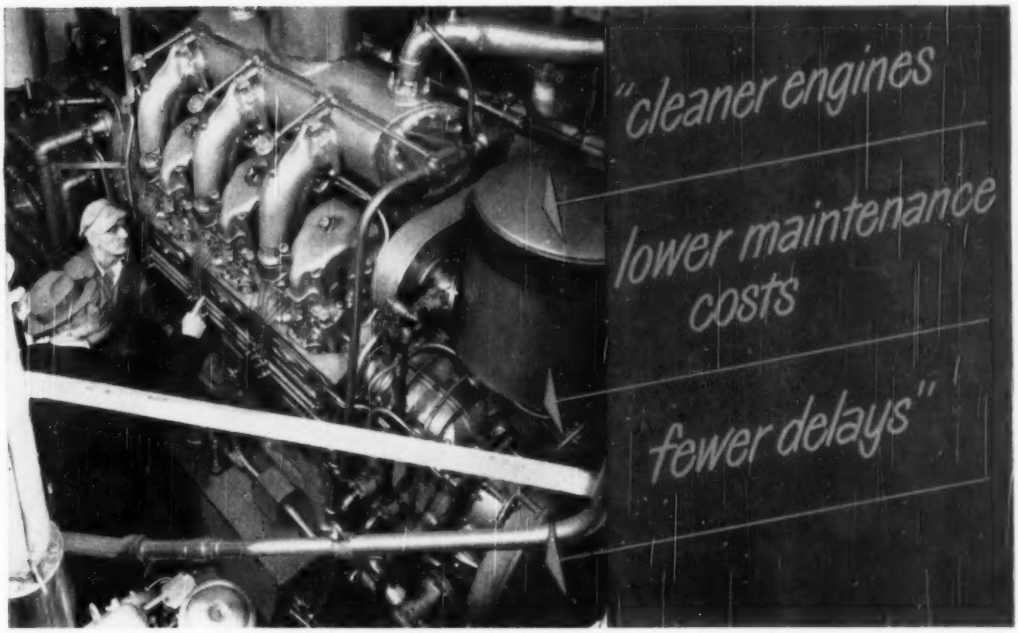
Oil Transfer Pumps

Cooling Water Circulating Pumps

Evaporative Type Engine Water Cooler

"We get better lubrication with *Gulf Dieselmotive Oil*"

say Diesel operators



More and more Diesel operators are specifying Gulf Dieselmotive Oil, the outstanding detergent-type lubricant for industrial, marine and railroad Diesels. They report that this quality oil provides effective protection against excessive wear and at the same time keeps engines clean.

Solvent refined from quality crude stocks, Gulf Dieselmotive Oil contains a highly effective detergent for best results in heavy duty service. It helps keep rings sludge-free—prevents ring sticking, excessive oil consumption, and blow by. This means fewer operating delays, fewer overhauls, lower maintenance costs.

Here's practical help on any lubrication or maintenance problem for the user of Gulf Dieselmotive Oil: the cooperative services of a trained Gulf Lubrication Engineer. Write, wire, or phone today and ask a Gulf Lubrication Engineer to call.

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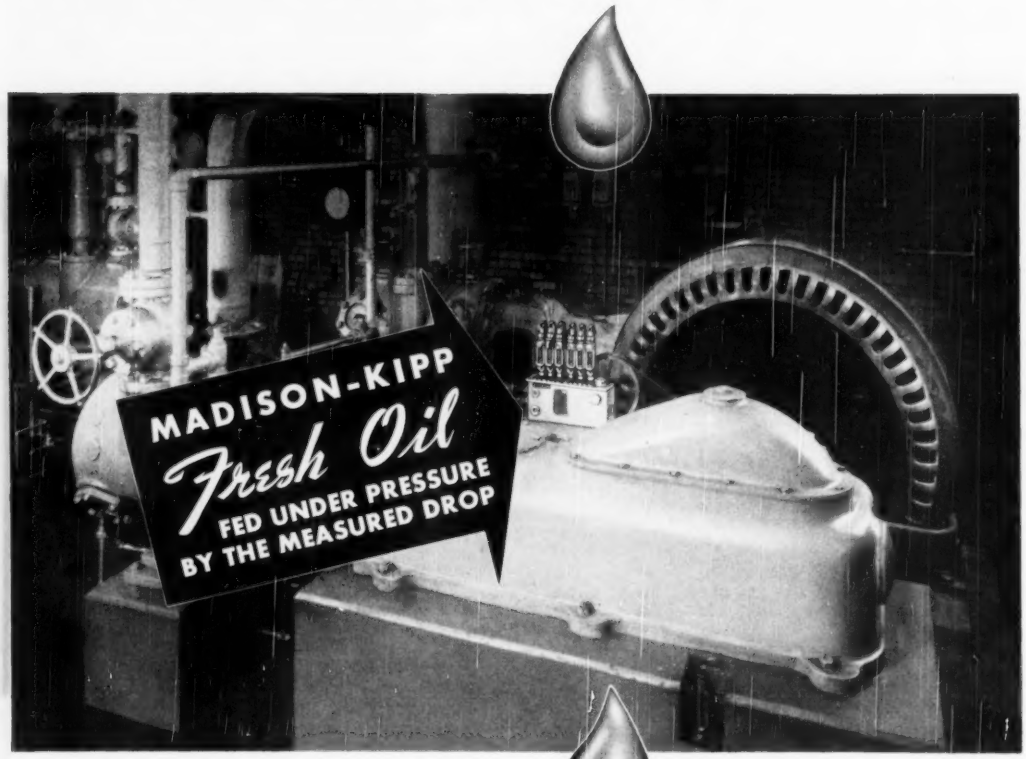
USE THE MOST DEPENDABLE OILING

SYSTEM EVER DEVELOPED



Madison-Kipp Lubricator Model SVH, providing controlled force-feed lubrication through non-clouding sight feeds to the cylinders of an Ingersoll-Rand XRE-1 Synchronous - motor - driven Ammonia Compressor. There are Madison-Kipp Lubricators for original standard equipment for almost every type of machine tools, work engines, and compressors.

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- *Experienced in* LUBRICATION *Engineering*
- *Originators of Really High Speed* AIR TOOLS

Dirt-Proof

your Fuel and Lube Oil
With AC Elements

FOR FUEL FILTERS

FOR LUBE OIL FILTERS

Millions of hours of service stand behind the AC Fuel Oil Elements engineered for factory equipment Diesel fuel filters. For their full life, these precision-built elements actually "Dirt-Proof" the fuel. As protection for fuel injectors and transfer pumps, AC Elements are unequalled.

Standard equipment on G.M.C. Truck and Coach, Flxible Bus, and Detroit Diesel.

AC Elements are also available for nearly every make of lubricating oil filter.

These AC Elements are so efficient that they "Dirt-Proof" your lube oil.

ONLY CLEAN OIL IS SAFE OIL!

AC OIL FILTERS

AC SPARK PLUG DIVISION • GENERAL MOTORS CORPORATION

THE fight is on to save more lives in 1950! Now is the time to back science to the hilt in its battle against cancer.

Important gains have already been made. Last year, 67,000 men, women and children were rescued from death by cancer. Many more can be saved—if *you* resolve to save them —if *you* strike back at cancer.

Give! Give your dimes and quarters and dollars. More treatment facilities are needed, more skilled physicians, more medical equipment and laboratories. The success of great research and educational programs depends on your support.

Your contribution to the American Cancer Society supports these vital efforts. It helps guard your neighbor, yourself, your loved ones. So this year, strike back at cancer . . . Give more than before . . . Give as generously as you can.

AMERICAN CANCER SOCIETY

. . IN BUS POWER
This is the Diesel
that gave power users new ideas
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SHOW an engineer a better source of power and things start happening fast.

That's illustrated by events since General Motors first introduced the "71" Series of two-, three-, four- and six-cylinder Diesel engines, ranging from 50 to 200 horsepower—little brothers of the famed two-cycle GM Diesels that drive so many crack American passenger and freight trains.

Bus engineers went for the "71" at first sight. They liked its compactness, its fuel economy, its clean-burning operation. Now more than 20,000 city and inter-city buses are powered by GM "71" Diesel engines.

Army and Navy engineers approved its rugged strength and dependability. During the war they used 182,000 GM "71" Diesels to operate landing craft, tanks, tractors, bulldozers and other military vehicles.

So, too, have designers of all types of power-driven equipment turned to the GM "71" for low-cost efficient power. Today they are using it in heavy-duty trucks, tractors and earth movers, in work and pleasure boats, in cotton gins, lumber mills, oil rigs and for many other mobile, portable and stationary uses—*with remarkably successful results!*

That is because the GM "71" is a two-cycle engine that delivers power on every piston downstroke—in contrast to most Diesels that deliver power only on every second downstroke. This makes GM Series 71 Diesels more compact, lighter, faster-accelerating, smoother, cleaner-burning—*and twelve years' experience in applications totaling over 46,000,000 horsepower proves it!*

The GM "71" gives you Diesel brawn without the bulk. *It is Diesel power at its best.*

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SINGLE ENGINES . . . Up TO 275 H. P. **DETROIT 28, MICHIGAN** MULTIPLE UNITS . . . Up TO 800 H. P.

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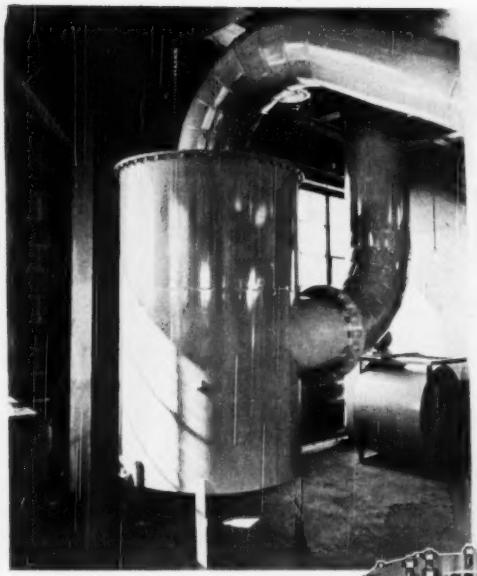
GM
GENERAL MOTORS
DIESEL POWER
"Your Key to Power Economy"

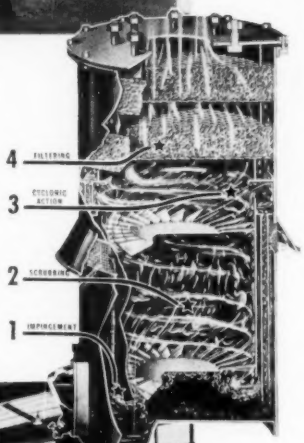
Only GM Diesels provide all these advantages

Smaller size, less weight per horsepower • Two-cycle smoothness, power on every downstroke • Quick starting, on its own fuel • Unit injectors—no high-pressure fuel lines • Rapid acceleration • Cleaner burning • Better high-altitude performance • Easy accessibility

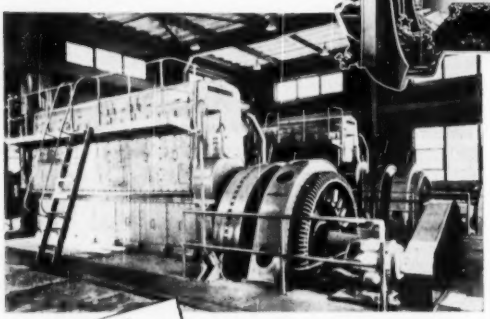


let it snow!

this Cycoil® is indoors out of the weather



Cycoil Oil Bath Air Cleaner provides 4 way cleaning — Impingement, Scrubbing, Cyclonic Action and Filtering.
Filtration through Double Cells completes cleaning action eliminating oil mist from air.
Cyclonic action induced by vanes throws oil containing dust outward.
Scrubbing action, thoroughly mixes air and oil, entraining all dust particles.
Impingement of dirty air against oil, deposits the heavier dust particles immediately. Oil and air mixture then passes upward with whirling motion through vanes to succeeding cleaning steps.



These 1425 H.P. Nordberg Diesels breathe the world's cleanest air, made that way by AAF—the world's greatest name in air cleaning.

Today's Best Buy is Better Air!

THIS Cycoil* at the Milford, Maine plant of Bangor Hydro-Electric Company has a tangential intake and is housed indoors for cold-weather protection. This type of intake keeps oil flowing when the mercury indicates "no-pour" temperatures. Cycoil is adaptable to many conditions—maintains steady year 'round function to protect costly engines.

With Cycoil, these Nordberg Diesels have the best known protection for uninterrupted service. AAF's Cycoil cleans the intake air for diesels in 4 ways, as explained in the drawing above. Its oil bath and cyclonic action removes more than 90% of all dust by oil immersion. Intense centrifugal action captures dust particles even before the air is filtered. Positive oil circulation maintains a self-cleaning action. Final air cleaning by filter pads in a double cell design offers nearly 100% dust elimination. For large dust-handling capacity, AAF's Cycoil has no equal. Just ask a diesel engineer.

Whatever your problems with air, to protect engines for continuous operation, call upon AAF's air experts.

For engineering details and complete explanation of performance standards on Cycoil write for Bulletin 130-E.

*Oil bath air cleaner

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445 Central Ave., Louisville 8, Ky. • *In Canada:* Darling Bros., Ltd., Montreal, P. Q.

STANDARD ENGINEER'S REPORT

RPM DELO

TEST DATA

LUBRICANT *RPM Delo Supercharged Lubricating Oil*

UNIT *Caterpillar Diesel-D17000-V8 Cyl.*

CONDITIONS *Cont. High load-actual field oper.*

FUEL *Commercially available Diesel Fuel*

TEST PERIOD *4 months*

FIRM *Homer Jones Ranch, Chandler, Ariz.*

Stopped all ring sticking where ordinary oil failed!

AFTER ONLY 625 HOURS operation on an ordinary heavy-duty type oil, an engine pulling 90% of full load rating had 39 stuck rings — only 9 of its 48 rings were free and several were broken. There were heavy lacquer and carbon deposits in ring grooves and on piston-skirts, as indicated by this unretouched photograph of one of the pistons. Besides stuck rings, note clogged oil-return holes and oil rings.

OPERATED 1582 HOURS — more than twice as long — on RPM DELO Supercharged-2 Lubricating Oil, the same engine, running under the same load and fuel conditions, stayed efficient and clean, as this unretouched photograph shows. At the end of test all 48 rings were free, with no piston-skirt deposits. Ring-groove deposits were 50% less. Note how RPM DELO Supercharged-2 kept oil-return holes open.

REMARKS: RPM DELO Supercharged-2 Lubricating Oil is one of four grades in the RPM DELO Oil line. It solves operating problems in both Diesel and gasoline engines, especially where load conditions are extreme.

Its detergent prevents carbon and lacquer deposits on all parts, even with high sulphur-content fuels.

RPM DELO Supercharged-2 Oil sticks on hot and cold surfaces — reduces wear under the heaviest loads. (Cylinder-wear averaged only 0.0014 inches per 1000 hours with RPM DELO Supercharged-2, while with the ordinary oil it was 0.0043 inches — three times greater.) RPM DELO Supercharged-2 Lubricating Oil also contains special compounds that resist oxidation and sludging, prevent bearing corrosion and internal rusting, and stop foaming.

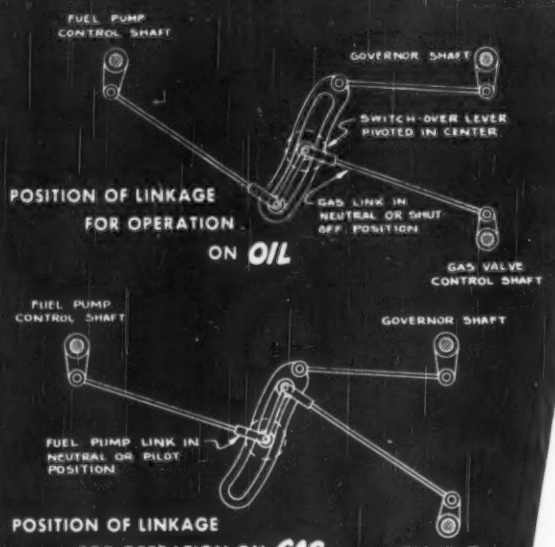
FOR MORE INFORMATION about the proper grade of the new RPM DELO Oils to fit your particular requirements, or the complete line of RPM Lubricants, and the name of your nearest "RPM" Distributor, write or call any of the companies listed below.

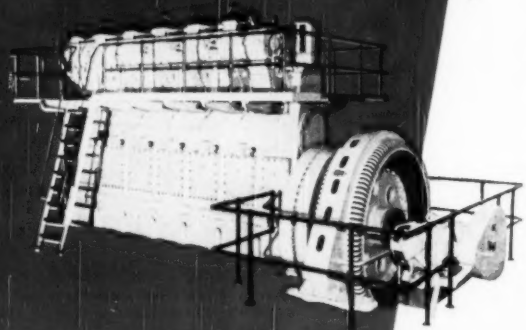
STANDARD OIL COMPANY OF CALIFORNIA • San Francisco
THE CALIFORNIA OIL COMPANY • Barber, N. J., Chicago
STANDARD OIL COMPANY OF TEXAS • El Paso, Texas
THE CALIFORNIA COMPANY • Denver, Colorado

now far faster, 2-second changeover!
far more sensitive speed control!
far more dependability!

*WITH NEW PATENTED**

FULTON DUAL-FUEL


FUEL PUMP CONTROL SHAFT
GOVERNOR SHAFT
SWITCH-OVER LEVER PIVOTED IN CENTER
POSITION OF LINKAGE FOR OPERATION ON OIL
GAS LINK IN NEUTRAL OR SHUT OFF POSITION
GAS VALVE CONTROL SHAFT
FUEL PUMP CONTROL SHAFT
GOVERNOR SHAFT
FUEL PUMP LINK IN NEUTRAL OR PILOT POSITION
POSITION OF LINKAGE FOR OPERATION ON GAS
GAS VALVE CONTROL SHAFT



SUPER-SIMPLE SWITCHOVER UTILIZING FULL GOVERNOR STROKE ON BOTH OIL AND GAS

(any ratio of oil and gas obtainable)

The diagrams tell the story. No other dual-fuel engines offer you anything like the simplicity, speed and efficiency of this exclusive FULTON feature. What's more:

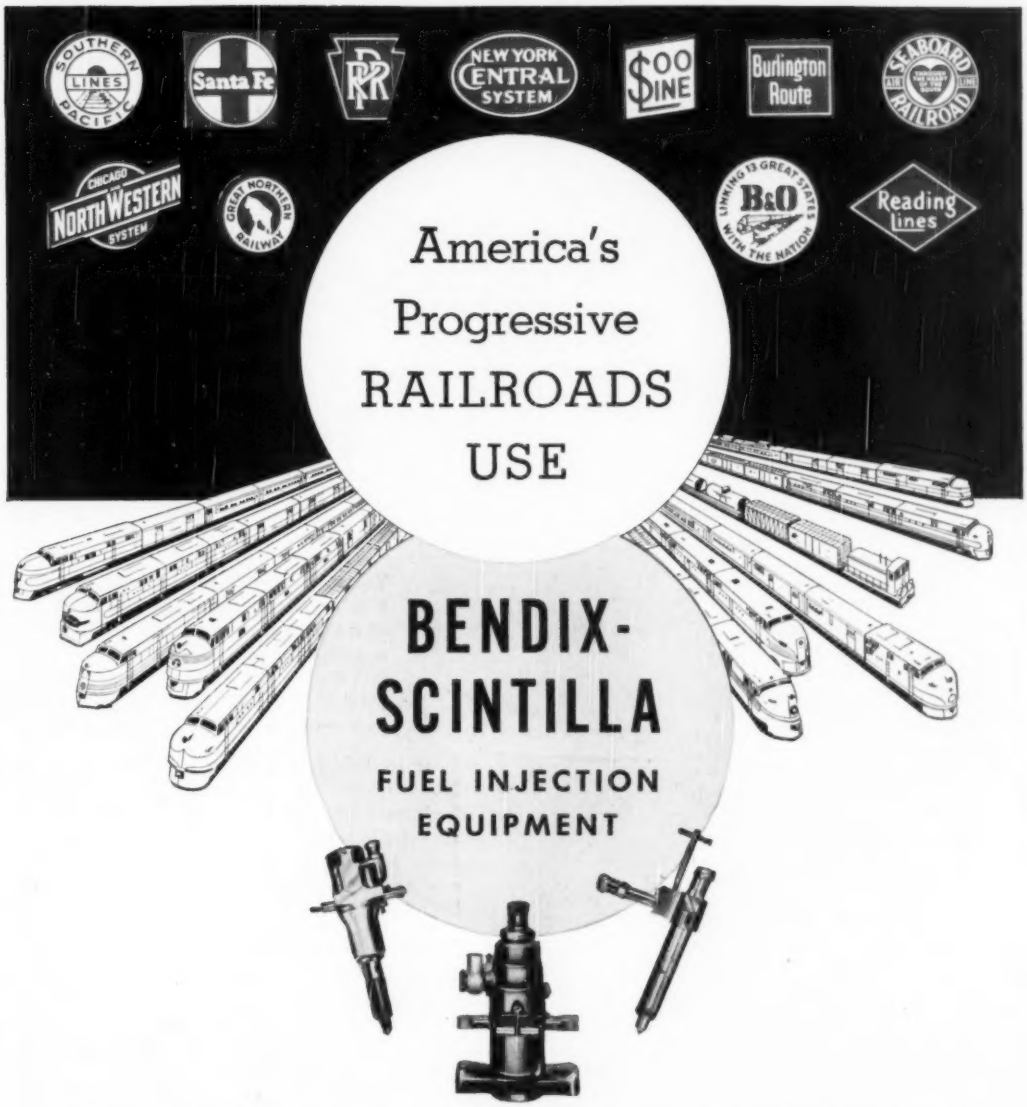
- you can change instantly to either fuel by PUSH-BUTTON REMOTE CONTROL... from your office seat or at mutiple control points anywhere in the plant;
- if line gas pressure drops, FULTON DUAL-FUELS *automatically* switch to oil. We invite your inquiries on these years-ahead FULTON advancements.

* U. S. Patent No. 2509960

FULTON

FULTON IRON WORKS CO.
SAINT LOUIS 14, MISSOURI

FOR DEPENDABILITY AND OPERATING ECONOMY



Evidence of the dependable performance of Bendix-Scintilla fuel injection equipment is furnished by the ever growing list of distinguished railroads using this equipment. On switchers or deluxe streamliners operating schedules must be maintained consistently and economically.

Bendix-Scintilla is proud of the increasingly important part its fuel injection equipment is playing in helping to maintain today's high standard of railroad efficiency. And for the future, the resources of Bendix-Scintilla are dedicated to meeting tomorrow's transportation problems.

BENDIX SCINTILLA

SCINTILLA MAGNETO DIVISION OF SIDNEY, NEW YORK

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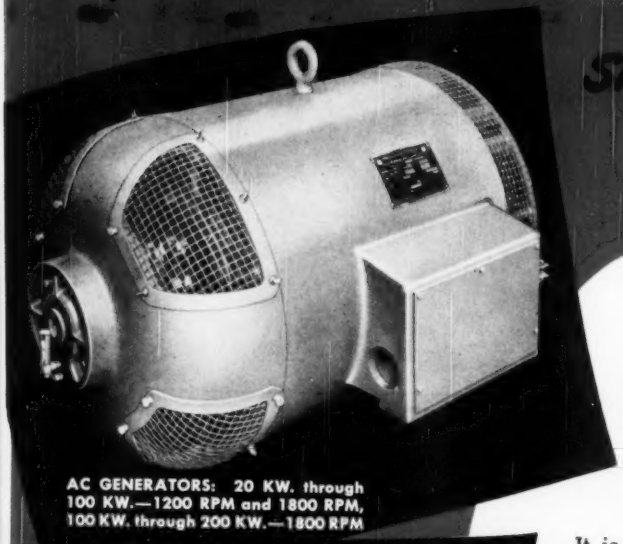
Bendix AVIATION CORPORATION

DELCO GENERATORS

spendthrifts on POWER

skinflints on COSTS



AC GENERATORS: 20 KW. through 100 KW.—1200 RPM and 1800 RPM, 100 KW. through 200 KW.—1800 RPM

DC GENERATORS: 20 KW. through 60 KW.—1200 RPM, 75 KW.—1500 RPM

To provide a dependable source of electric power is the primary purpose of a generator, it is true. And to find a generator that will supply electric power at a *low cost per year* is the goal of all manufacturers of Diesel power-and-light equipment.

It is in this low-cost-per-year aspect that Delco generators are favored. They have features of design which yield advantages in size, weight and ease of service; they have features of construction and items of equipment which are often classed as *extras* but which remain *standard* with Delco.

Power range of Delco generators for Diesel stand-by and portable equipment is from 20 through 200 KW. — AC and DC — 1200, 1500 and 1800 RPM. Any of the sales offices listed below will be glad to supply detailed information.

DELCO GENERATORS

DELCO PRODUCTS

Division of General Motors Corporation, Dayton, Ohio

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EATON

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Registered U. S. Patent Office

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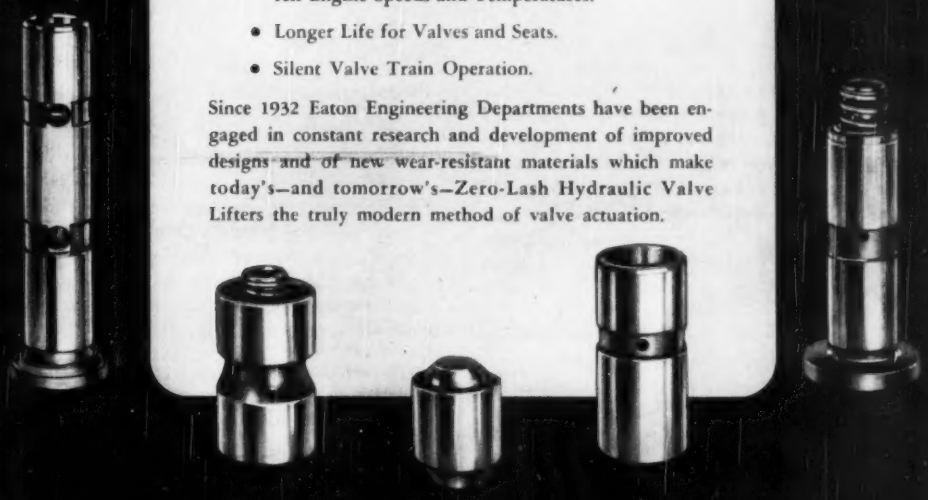
The Modern Method of Valve Actuation

Millions of Zero-Lash Hydraulic Valve Lifters and Zero-Lash adjusting units—designed and developed exclusively by Eaton Manufacturing Company—have gone into leading automotive, aircraft, tractor, marine and industrial engines in the last 17 years. They have contributed:

- Freedom from Tappet Adjustments for the Life of the Engine.
- Accurate Valve Timing and Perfect Seating at All Engine Speeds and Temperatures.
- Longer Life for Valves and Seats.
- Silent Valve Train Operation.

Since 1932 Eaton Engineering Departments have been engaged in constant research and development of improved designs and of new wear-resistant materials which make today's—and tomorrow's—Zero-Lash Hydraulic Valve Lifters the truly modern method of valve actuation.



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"The experience of those who have made the changeover from standard to heavy fuels has varied considerably from success to failure. The reason for this wide diversity of results is due to the unpredictable behavior of heavy fuels. Differences in timing, duration and the characteristics of combustion—such as after-burning of the heavy ends—can create serious operating and maintenance problems *unless provision is made for these changes.*

"Since these changes in the combustion phenomena have an important effect on piston ring performance, Cook has made extensive studies into the subject of heavy fuels. Using electronic indicators and the latest scientific instruments, Cook has done more in this field, perhaps, than any other ring manufacturer. Cook engineers are constantly in the field analyzing all makes of engines under all types of operating conditions. The data thus obtained has turned up many new findings as to the requirements and adjustments needed to burn heavy fuels successfully, and has put Cook engineers in a position to make sound recommendations as regards your own case."

Cook calls this work "job-engineering", for it permits ring recommendations to be tailored to your own specific operating and engine conditions. If you are burning heavy fuels now or are thinking of changing over, it will pay to call in Cook engineers today to get a "job-engineered" recommendation. Their advice and cooperation costs nothing and may save you untold hundreds of dollars in operating and maintenance costs.

C. Lee Cook Mfg. Co., Incorporated, Louisville, Ky. Branch offices in Baltimore, Boston, Chicago, Cleveland, Houston, Los Angeles, Mobile, New Orleans, New York, San Francisco and Tulsa.

COOK GRAPHITIC IRON PISTON RINGS

SEALING PRESSURES SINCE 1885

Diesel Power

and DIESEL TRANSPORTATION

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Vol. 28 No. 10 October, 1950

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Cover Photo:

With water roaring over Grand Coulee Dam in the background, this General Motors diesel powered Euclid truck is shown dumping a load of giant rocks at the water's edge.

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SPECIAL FEATURE

Diesels in the Construction Industry 38

The second in a series of articles dealing with the application of diesels in the various industries in the nation.

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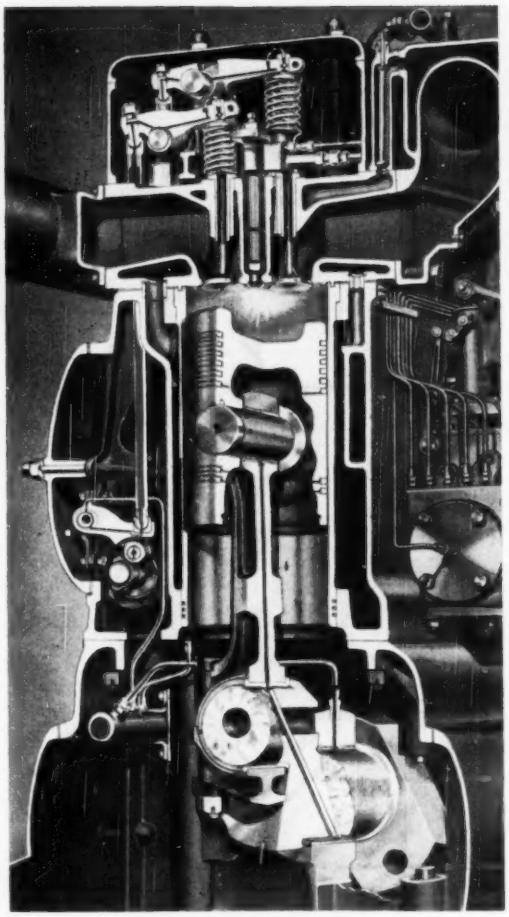

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Editorial:

British Viewpoint on American Productivity

TEN PRODUCTIVITY Teams, under the sponsorship of the Anglo-American Council on Productivity, have visited our shores. The most recent represented the British Internal Combustion Engine Industry. The prime interest was to study for later comparison the "how" and "why" of productivity rather than design technology. Visits to ten representative plants operating on mass production, eight of them producing diesels, served as a fairly good cross section for their purpose.

First consideration in the report is given to the causes of our high productivity. Type of market, British predominantly export and ours mainly domestic, is considered an underlying factor. Prediction of foreign markets with their wide requirements as to engine type as well as limited volume is considered to be more difficult with a resultant hesitation toward extensive capital investment. Our home market and knowledge of application permits us to standardize products to a greater degree.

The easy supply of machine tools, even of specialized types, was thought to be a factor in our productivity because of the great flexibility allowed in re-tooling programs. Production volumes permit the use of this specialized tooling. As a result, the supply is greater and our plants use more of this type of tooling than do their British counterparts.

Availability of supplies of both rough or finished components is quoted as being considerably better in this country. This, of course, permits greater flexibility of operation and quick stock turnover.

Labor utilization is at a higher level here. The Team called attention specifically to our practice of having a single operator run more than one machine even though different in function. The idea of adjusting labor requirements for the speeding or slowing of assembly line operation also seemed of interest to them.

In comparing the degree of individual skill, the Americans seem to suffer in that their training, while adequate for the particular job, is not as broad. This comes as no shock to any one familiar with the thorough and painstaking British apprenticeship system. The team questions, however, if it would not be advisable to consider our system and substitute a shorter more concentrated course for long apprenticeship.

Rank and file acceptance of the principle of time studies as a measure of productivity appeared to be noteworthy. Along with this was the productivity-consciousness at all levels. Inclusion of these and other mentioned practices in this report would imply that such is not the practice in the United Kingdom.

Finally, comes the matter of incentives—what makes the drive? This is ascribed to a wide spread aspiration for a higher standard of living. It is pointed out that the net return to all, from the unskilled worker to the executive, is higher than in Great Britain. On the other hand, British income taxes are generally higher. In the lower brackets it is not substantially different but it takes a sharp upward turn just when the worker is considered to be making good money.

The abundance of American life is pointed out in the matter of food, both in quantity and variety, and all other consumer goods. Attention is also called to the extent of purchasing on the hire-purchase (dollar down and dollar when you catch me) system. It all adds up to the fact that the availability of attractive goods is an incentive to increase purchasing power.

For the next factor, we quote, "In this competition for a higher standard of life it is undoubtedly the American woman who is the pacemaker." Then in a burst of Churchillian prose—" . . . the American worker has unquestionably well 'prepared himself unto the battle', and the trumpet, sounded by his wife, and to which his unflagging efforts are often the valiant response, does not usually give 'an uncertain sound.'" The Team makes this comment with no implication of disparagement but rather of commendation.

This summation has been confined to the single theme of productivity. The report also gives consideration to "Management and Labor", "Production Methods", "Trends of Design", and "Pricing". Viewing their conclusions and recommendations to their industry, we deduct that the Team was well impressed with our system and would like to adopt such of our methods as could be applied to their particular scheme of things.

WHY, THE MAN HAS HOLES IN HIS HEAD!

You can't protect yourself against a mid-winter storm with a light summer suit . . . and you can't protect your fuels and lubricating oils with inadequate filters. It's as simple as that. Yet, there are some men who try. They try because they think they can save a few pennies, but instead of making a saving, sooner or later they lose their shirts . . . right out from under their linen suits.

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+ HIGHLIGHTS +

● A Brown Boveri gas turbine locomotive is now operating on the German Federal Railways.

● The B & O has announced the purchase of two diesel railcars from the Budd Company for its Baltimore-Washington-Brunswick runs.

● The directors of the Erie Railroad have authorized an $11 million expenditure for additional diesel equipment.

● The Middle Eastern District Meeting of the AIEE will be held in the Lord Baltimore Hotel, Baltimore, Oct. 3-5.

● A repeat order for 60 diesel-powered buses has been placed with Mack by the Trustee of Surface Transportation Corp. of New York.

● Earnings of Purolator Products, Inc., manufacturers of diesel fuel and lube filters and other products, amounted to $479,683 for the first half of 1950.

● Detroit Diesel Engine Division of GM has purchased the former Stinson Aircraft Company plant and airport in Romulus Township, Michigan, and will use the plant to manufacture auxiliary generators for tanks.

● The Electric Auto-Lite Company which makes diesel starting batteries among other things, reports consolidated net sales of $94,423,558 and net earnings of $5,187,591 for the first six months of the year.

● Believed to be the only diesel operating on gas in Wisconsin, a Nordberg Duafuel engine recently completed its first year of operation in the Elkhorn Light and Water Commission plant.

● Diesel locomotives handled nearly 50 per cent of passenger-train car miles and nearly 35 per cent of freight gross ton-miles in 1949, yet numerically, accounted for only about one third of the total number of locomotives in operation.

● General Motors produced 364,942 passenger cars and trucks in August. Of this total, 58,479 were trucks.

● The Louisville & Nashville RR. has announced the purchase of 41 diesel-electric locomotives for road freight and yard service.

● The Baldwin Locomotive Works has announced receipt of an order from the Pennsylvania Railroad for 108 diesel locomotive units.

● The 94th successive quarterly dividend to stockholders of the Perfect Circle Corp. was declared recently by the corporation's Board of Directors.

● Consolidated net earnings of Mack Trucks, Inc. totalled $64,402 for the first half of the year. This compared to a net loss of $1,653,294 for the same period last year.

● In the report for the first half of the year, the MKT railroad said, in part: "Lower transportation expense was made possible by reason of increased operation of diesel power . . .".

● Between July 19 and August 18, the CPR received four 1500-hp. diesel freight locomotives from the Montreal Locomotives Works, making a total of 10 received on an order for 20 locomotives.

● In the report on the first six months' operations of the Rock Island RR, the railroad says: "The efficiency and economy from the use of diesels has been so fully demonstrated throughout the country that a completely dieselized property is highly desirable."

● Simultaneous testing of all three cells in a 6-volt battery is possible through the use of a simple hookup devised by an employe of the Naval Supply Depot, Bayonne. The portable test unit consists of a voltmeter placed across each cell, and a solenoid which, when energized, applies a load to the battery and immediately exposes a faulty cell.

● The Detroit Diesel Engine Division's overall production of engines reached 46 million horsepower in July.

● The City of Stockton, Kansas, has recently added its sixth F-M diesel to its power plant. The new engine is a 520 hp. dual-fuel engine.

● Armstrong Siddeley Motors, Ltd., has recently introduced a twin-cylinder air cooled diesel engine rated at 14 to 20 bhp. at 1000 to 1500 rpm.

● A hand operated hydraulic starter, particularly applicable to diesel engines, will soon be manufactured in Britain by Bryce Fuel Injection, Ltd.

● The Manitou and Pike's Peak Railroad became completely dieselized when it commenced operation for the summer season.

● The number of tractors on farms has risen to 3,550,000 at the start of this year, an increase of 300,000 units over the figure at the beginning of 1949.

● Five hundred cases of parts for Mack trucks and buses, including 16 Mack diesel engines, recently left New York for Buenos Aires. The shipment, valued at $275,000, is part of an $800,000 order.

● In the first quarter of this year, British Industry produced 24,832 diesel engine units which will produce a total of 739,334 bhp. according to the August issue of The Oil Engine and Gas Turbine.

● New York City Board of Transportation recently placed an order for 400 diesel buses with Mack trucks. This is the largest bus order placed with any manufacturer in the last few years.

● The Sulzer 4400 hp. diesel locomotive on the French National Railways has now completed over one million km. in express passenger service. The locomotive is the most powerful high speed diesel operating in Europe.

Diesels in the Construction Industry

This is the second in a series of articles dealing with the use of diesels in this country. The first article dealt with the railroad industry. This article treats of the place in the construction industry of diesel engines and traces the ever-increasing use of diesels in all types of construction machinery.

by George W. Grupp

CONSTRUCTION in this country has grown to be one of the largest industries in the nation. Employing tremendous numbers of men and utilizing vast quantities of equipment, it stands today as one of the country's major industries.

This country has afforded great opportunities to men in the construction industry, chiefly because it was literally hacked out of a wilderness. In less than two hundred years, almost half a continent has been transformed from broad plains and dense forests to great cities and towns, connected by the finest system of highways and roads in the world. Virtually no place in this country can today be termed isolated or completely undeveloped.

This tremendous growth and development would have been impossible without the use of mechanical equipment. The use of machines in the place of manpower has increased a great deal in the past hundred years and is today increasing at a greater pace than ever before.

Diesel powered equipment on a highway construction job in Brezil. In the foreground is a tractor and in the background is a tractor equipped with side boom which is pulling a scraper.

With the steadily increasing average hourly wages in the construction industry during the past fifty years mechanization became a necessity. For example, the Highway Research Board of the Public Road Administration found that the average cost of highway maintenance in 1948 was 33 per cent higher than the average cost for the same work in 1935.

This example explains in part why, during the past 25 years, self-propelled and tractor-drawn construction equipment steadily increased in usage for earthmoving, bridge building, flood control work, power development, factory expansion projects and road building.

The upward trend in mechanization of road maintenance indicates the trend of the entire construction industry to use more and more labor saving machinery. For the maintenance of 392,418 miles of rural roads a total of 145,795 men and 74,431 units of equipment were used in 1936. For the maintenance of 550,000 miles of rural roads a total of 115,178 men and 130,010 units of equipment were required in 1948.

The rising construction industry wage rates have not only stimulated the use of construction equipment to replace costly hand labor, but they

Diesel tractor pulling a scraper on the Alkan highway. A great deal of diesel powered equipment was used on this project during the war.

have also furthered the demand for, and the production of, larger and more efficient machinery to replace obsolete equipment to attain increased productivity and to decrease construction costs. To put this another way, the reduced hours of the construction industry work week are offset by machinery with increased productivity. For example, a front lift diesel shovel with one operator can perform the work of fifty men.

The quantity of construction machinery produced in the United States, powered by diesel and other types of engines, can be gleaned from the accompanying table which was compiled from reports in the offices of the United States Department of Commerce.

International TD-14 equipped with Bucyrus-Erie 12-foot bulldozer at work on a bridge on the Blue Ridge Parkway in western Virginia.

First Diesel Used by Construction Industry

Diesel engines were not used as a source of power for construction machinery until 1926 when a gasoline engine was replaced by a diesel engine in a tractor being used on one of the big engineering projects of the West.

Since then, and especially in recent years, there has been a rapid increase in use of diesel engines in cranes and power shovels as well as every other kind of construction machinery. This growth is due to manufacturer research and development efforts, and to the contractors acceptance of diesel engines as a reliable and economical form of power. This acceptance is largely the result of dealer and manufacturer maintenance and parts services to the contractors. As a result, construction machinery in the United States is now powered with countless millions of horsepower of energy produced by diesel engines.

Diesel Powered Construction Equipment

Today, diesel engines are used in excavating, in pile driving, in pumping fresh and raw water, concrete and sewerage, in hauling materials, in loading, and in construction camps for power and lighting purposes. To put this another way, in addition to the equipment listed in the tables some of principal types of construction machinery which are powered with diesel engines are:

Back hoes, Batcher equipment, Bituminous equipment, Cement spouting plants, Conveyors, Crusher plants, Ditchers, Derricks, Finishing machines, Generators, Hoists, Light and power plants, Marine construction equipment, Pile drivers and extractors; Pumps, water, sewerage and concrete; Scrapers, Scarifiers, Screening plants, Spreaders, Stump pullers.

Some of these types of construction equipment, with or without special attachments, are able to perform a number of different functions. For example, a front end loader can be used for loading trucks with rocks or snow, for ripping up pavements, for ditch cleaning, for leveling and cleaning up, for clearing and grubbing, for picking up large boulders, and for serving aggregate plants.

Selection of Equipment

In the selection of diesel powered construction equipment the first thing the contractor should do is to consider (1) the duration of the job, (2) the length of hauls, (3) the quantity and kind of materials to be moved, (4) the climate in the area of the project, and (5) the type of jobs he intends to handle in the future.

The next step is to decide if standard or special equipment should be used. Naturally the first cost of special machinery will be higher than standard equipment. Then too, parts for special equipment are more difficult to obtain. But in spite of this, special equipment may be more economical in certain types of work as

Caterpillar diesel D5 tractor and No. 60 scraper grading right-of-way along road to be rebuilt north of Sparr, Fla.

has been found to be true in some of the huge irrigation construction projects of the West, and in some petroleum pipe line construction projects in the Near East.

Economic Factors of Selection

From an economic point of view a piece of construction equipment should not be bought if it does not

(1) *Improve workmanship and technique,*
(2) *Reduce performance time,*
(3) *Reduce hand labor,*
(4) *Reduce accidents,*
(5) *Reduce over-all construction costs, and*
(6) *Aid in competitive bidding.*

In weighing the economic value of two makes of the same type of equipment, or a piece of standard equipment with special equipment, a higher first cost is justifiable when it results (1) in lower annual operating, repair and maintenance costs, (2) in a reduction of the number of renewals of parts, (3) in increased productivity, (4) in labor saving, and (5) in maximum availability.

No good comes from buying a low priced piece of equipment if its operating and maintenance costs absorb the savings which would accrue from a more efficient higher priced machine.

The selection of the proper size of equipment depends on the size of the job and the contractor's future possible usage of the machinery. For example, it would be impractical for a small contractor to buy one large piece of equipment when the purchase of several small units would be more advantageous. And since construction equipment is usually worn out and obsolete in a few years care should be exercised to attain economic selection and retirement.

Mechanical Factors of Selection

From a mechanical point of view, construction equipment should have (1) power, (2) weight, and (3) good traction. Other mechanical factors which should be given careful consideration in the selection of construction equipment are accessibility of parts, dependability, durability, ease of control and operation, flexibility, interchangeability of parts, mechanical efficiency, maximum availability, operator's comfort, possible utilization, range of mechanical adjustment for various needs, roadability, and dealer and manufacturer parts and maintenance services.

Equipment Sizing

It is bad management for a contractor to tell his operators: "Pile it

Contractors' Equipment Ownership Expenses

Type of Diesel Construction Equipment	Average Annual Expense. Percent of Capital Investment without field repairs. Depreciation	Overhauling, major repairs, painting	Interest, Taxes, Storage, Insurance	Total Ownership Expenses	Average Use Months Per Year	Expense Per Working Month Percent
Air Compressor, Portable						
105-185 cu. ft.	25	15	11	51	6	8.5
210-630 cu. ft.	20	15	11	46	6	7.7
Backfiller, Crawler tractor						
40-50 belt h.p.	25	15	11	51	9	5.7
65-80 belt h.p.	20	15	11	46	8	5.8
Cranes, Crawler						
6-12 tons—10 ft. radius	20	10	11	41	8	5.1
7-12 tons—12 ft. radius	20	10	11	41	8	5.1
14-18 tons—12 ft. radius	17	10	11	38	7	5.4
20-50 tons—12 ft. radius	13	10	11	34	7	4.9
9-12 tons—45 ft. radius	20	10	11	41	8	5.1
18 tons—45 ft. radius	17	10	11	38	7	5.4
Cranes, Locomotive						
15-20 tons—10 ft. radius	13	10	11	34	8	4.3
25-40 tons—12 ft. radius	13	10	11	34	8	4.3
Cranes, Truck						
4-6 tons—10 ft. radius	25	15	11	51	8	6.4
8-12 tons—10 ft. radius	20	15	11	46	8	5.8
15-20 tons—10 ft. radius	17	10	11	38	7	5.4
Drag Line Excavator, Crawler						
½ c.y. 35 ft. boom	25	15	11	51	9	5.7
1 c.y. 40-45 ft. boom	21	15	11	47	7.5	6.2
1½ c.y. 45 ft. boom	18	15	11	44	7	6.3
2½-3 c.y. 60 ft. boom	16	15	11	42	7	6.0
3½-4 c.y. 70-75 ft. boom	15	15	11	41	7	5.9
Drag Line, Walking						
5-12 c.y. 100-175 ft. boom	10	12	11	33	7	4.9
Grader, Self Propelled, Pneumatic tires						
Single Drive 4-13 tons	20	15	11	46	8	5.8
Tandem Drive 4-10 tons	20	15	11	46	8	5.8
All wheel & steer Drive 8-12 tons	20	15	11	46	8	5.8
Lighting Plants, AC or DC						
500-2500 watts	15	15	11	41	6	6.9
3000-100,000 watts	15	10	11	36	6	6.0
Locomotives, Standard or Narrow Gauge						
10 tons	17	12	11	40	8	5.0
15 tons	14	12	11	37	8	4.6
30 tons	12	12	11	35	8	4.4
Shovels & Back Hoes, Crawler						
½ c.y.	25	15	11	51	9	5.7
1 c.y.	21	15	11	47	9	5.2
1½ c.y.	18	15	11	44	8.5	5.2
2 c.y.	17	15	11	43	8	5.4
3½ c.y.	14	15	11	40	7.5	5.3
Shovels & Back Hoes, truck mounted						
¾ c.y.	25	15	11	51	9	5.7
1¼ c.y.	23	15	11	49	9	5.4
Tractor, Crawler						
20- 52 draw-bar h.p.	25	15	11	51	9	5.7
52-135 draw-bar h.p.	20	15	11	46	8	5.8
Tractor, 4 wheeled, rubber tired						
38- 47 draw-bar h.p.	30	15	11	56	9	6.2
47- 60 draw-bar h.p.	25	15	11	51	9	5.7
93-300 draw-bar h.p.	20	15	11	46	8	5.8
Tractor, 2 wheeled, rubber tired						
80-240 draw-bar h.p.	20	15	11	46	8	5.8
Tractor-trailer units, 2 & 4 wheeled						
85-240 draw-bar h.p. 10-32 c.y. scrapers	20	15	11	46	8	5.8
Tractor-Dump Trailer, 2 & 4 wheeled tractors						
80-200 h.p. 7.5-37 c.y.	20	15	11	46	8	5.8
Trenching Machines (ladder & vertical boom types)						
Depth 5- 8 ft. Width 8-24 inches	25	18	11	54	8	6.8
" 10-14 " " 10-42 "	20	15	11	46	8	5.8
" 14-17 " " 18-54 "	18	15	11	43	8	5.4
" 17-21 " " 20-52 "	17	15	11	43	8	5.4
" 21-26 " " 20-52 "	16	15	11	42	8	5.3
Trenching Machines, Wheel type						
Depth 3½-8½ ft. Width 30-90 inches	25	18	11	54	8	6.8
Trucks						
Stake Body 2 tons	25	12	11	48	9	5.3
" " 3½-5 tons	20	12	11	43	8	5.4
" " 10 tons	15	12	11	38	8	4.8
Dump Body 2 tons	25	15	11	51	9	5.7
" " 3½-5 tons	20	15	11	46	8	5.8
Heavy Duty dump body						
5-12 c.y.	20	12	11	43	8	5.4
15-18 c.y.	15	12	11	38	8	4.8
Engines						
Diesel 10 h.p.	15	15	11	41	7	5.9
Gas 10 h.p.	20	15	11	46	7	6.6
Diesel 15 h.p.	15	15	11	41	7	5.9
Gas 15 h.p.	17	15	11	43	7	6.1
Diesel 30 h.p.	12	12	11	35	7	5.0
Gas 30 h.p.	14	15	11	40	7	5.7
Diesel 35 h.p.	12	12	11	35	7	5.0
Gas 35 h.p.	13	15	11	39	7	5.6
Diesel 165 h.p.	10	12	11	33	7	4.7
Gas 165 h.p.	12	12	11	35	7	5.0
Diesel 200 h.p.	10	12	11	33	7	4.7
Gas 200 h.p.	12	12	11	35	7	5.0
Diesel 225-500 h.p.	10	12	11	33	7	4.7

Note: c.y.....cubic yards. Gas.....gasoline. h.p.....horsepower.

on, boys, and slam her into gear so that we can get this stuff moved." A policy which aims to overwork equipment results in frequent breakdowns and in quickly expended equipment. Perhaps it was profitable to adopt such a policy during the war when contractors operated on a cost plus, or high profit margin, basis. But those days are over.

The performance of diesel powered construction machinery depends on the proper assignment of equipment—equipment which can safely and economically perform a definite piece of work. This in turn depends upon the physical size of the construction project, the quantity and kinds of materials to be handled, the limitations of different machines, the proposed methods of operation, and the construction schedule.

Sizing the equipment has an important bearing on maximum performance efficiency. For example, a small power shovel may cause dump trucks to stand in line for too long a period of time to get maximum possible yardage haulage. On the other hand it is wasteful to assign to a job an oversized power shovel which has to remain idle waiting for haulage trucks. Then too, it should be remembered that there is a wide margin in basic cost-per-yard between a 3/8 cubic yard shovel and a 2½ cubic yard shovel. The amount of swing of a power shovel should be as small as possible because the difference between a long swing and a short one may be the difference of 75 per cent in productivity of the shovel. For example, a reduction of 30 degrees in swing cycle increases the productivity of the shovel 15 to 20 per cent.

Causes for Delays

Weather conditions are the chief causes for losses of utilization of construction equipment. Other causes are difficulties in servicing equipment, accidents and fires, strikes, failure of sub-contractors, high water damage, waiting for fuel and lubricants, waiting for loads or to load, lack of personnel, poor haul road, wrong equipment for the job, abusive or improper usage of the machines by operators which result in excessive repairs, and faulty servicing and maintenance of the equipment.

No operator should be permitted to run a piece of equipment before he is familiar with all aspects of its operation. He should know how the controls work. He should know how to properly make all gear shifts. He should know the correct speed for each kind of work because some tractors have eight speeds forward and reverse.

Operators should not be permitted to perform trick operations if the machine is to perform efficiently at low operating, repair and maintenance costs.

The Number of Construction Machinery Units Shipped By United States Producers for Domestic and Foreign Consumption

Type of Equipment	Calendar Years			
	1946	1947	1948	1949
Ditchers & Trenchers	625	948	1008	805
Carrying & Hauling scrapers	7921	6341	5782	3926
Wagons heavy duty (including tractor drawn carts, wagons, dump bodies & trailers, wheeled full or half track)	n.a.	1336	947	363
Graders, moter & others	6616	9804	12,941	9798
Rippers & Rooters	980	963	852	494
Rollers, self propelled, drawn, tamping, sheepfoot, portable	4389	4193	3066	2512
Loaders, portable, bucket line conveyor type	557	707	521	251
Cranes	n.a.	908	497	135
Power Cranes & Shovels	n.a.	n.a.	n.a.	1720
Shovel type loaders	n.a.	5444	5169	3072
Dozers, cable, angle & bull	18,036	5261	5558	4018
Dozers, hydraulic, angle & bull		21,966	13,095	10,396
Cable power control units	n.a.	9724	9565	6823
Tracklaying tractors	25,929	37,627	40,049	41,223
Wheel type, heavy duty industrial tractors	n.a.	4867	7243	1509
Portable well & blast hole drills	n.a.	2040	1641	807

Note: n. a.....Not available

Equipment Performance

An individual record of each piece of equipment should be kept. This record should give the equipment's history on performance, repairs and maintenance and cost of operation. This is necessary if degrees of performance efficiency and cost of operation per unit of service are to be learned and used for comparative purposes with similar pieces of machinery. This is also valuable information to have at hand when the contractors make bids for proposed work.

The work of all construction equipment should be carefully planned for a number of reasons. First, a loss of control of operation means high operating costs. Second, idle machinery due to a lack of work or mechanical failure does not earn money and the full benefit of investment in construction equipment is not obtained from obsolete machinery, or from equipment which is inefficiently operated.

When the right types of equipment are selected, properly operated, and correctly scheduled for performance they produce some interesting results. For example, 140 pieces of heavy earth-moving machines moved 250,000 cu. yds. of dirt at Peoria, Illinois in 48 hrs. Over in Bessarabia, 50-ton diesel ditch diggers are cutting 2.5 foot wide and 9.5 feet deep ditches at the rate of 7.5 lineal feet per minute. Down in Cheron, South Carolina, diesel engines, which replaced gasoline engines in two drag line cranes, paid for themselves in one year because of their fuel economy. In other words the fuel consumption of each crane per eight hours was 110 gallons with gasoline engines as compared with 40 gallons for the same period of time with diesel engines.

In a pipe line project which will extend from Texas to California, diesel ditchers are making 5½ foot deep and 44 inch wide trenches at the rate of one mile a day.

At the Bull Shoals Dam construction project a 100 hp. diesel engine propels a 74,000 foot long belt conveyor at the rate of 525 feet per minute with a carrying capacity of 650 tons per hour.

These are only a few examples of the many places where diesel powered

International TD-24 pulling a sheepsfoot roller on the Dorena Dam on the Row River, Oregon. The roller is 11 feet wide and each section weighs 65,000 lbs., making a total of 130,000 lbs.

construction machinery is performing efficient and economic services.

Operating Costs

A good performance record system is essential if the cost of various kinds of work are to be known. And a good performance and cost record system are essential for equipment comparison purposes and for successful bidding. Once a contractor's bid has been accepted he cannot change the amount to be received. The only thing he can do is control the job expenses and the cost of operating construction equipment.

In an effort to help contractors the Associated General Contractors of America made an exhaustive study of owners' costs of operating different types of construction equipment on a percentage basis of the first cost of the equipment. Naturally, these percentages are subject to some change according to an individual contractor's experience, his job location, the kind of work he does, the exposure of his equipment to the elements, his maintenance policy and his kind of operators. Depreciation is estimated on the straight line method. No salvage or scrap value of equipment is considered because of its insignificance. And no profit is included in the estimated total costs.

From the accompanying table, based on the figures supplied by the Associated General Contractors of America, a contractor can estimate the average annual cost of depreciation, maintenance and overhead expenses for about twenty-five different types of diesel powered construction equipment. In examining these percentage figures, it should be remembered that they do not include the cost of fuel, lubrication and field repairs. There is also included in this table a comparison of operating costs between comparable gasoline and diesel engines.

Live Storage

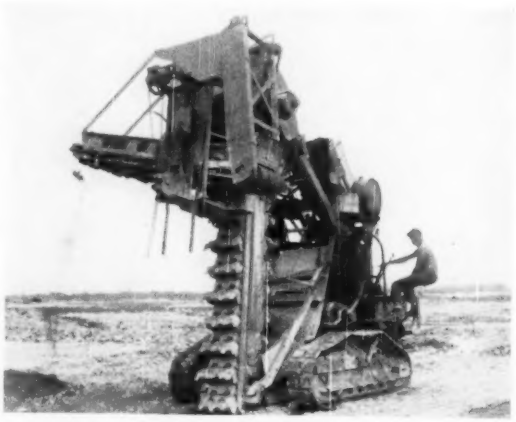
Large contractors usually have equipment pools at their construction camps from which units of machinery are dispatched to assigned tasks. These pools, and the "live storage" space at the contractors' home bases should be properly drained structures. They should have hard surfaced floors. And they should have ample room to protect all equipment from the elements.

Equipment placed in "live storage" should be thoroughly prepared and preserved. This means that before the equipment is placed in "live storage" it should be first thoroughly cleaned because dirt is a corroding agent. Second, the equipment should be properly inspected and repaired. Third, in the cold weather regions of the United States the cooling systems should be drained and protected with a rust preventive oil. Fourth, the clutches of equipment should be partially released to prevent sticking. Fifth, the equipment should be lubricated with the correct lubricants. And last, all tanks, and other parts of the equipment, should be coated with a good grade of rust preventive oil.

Maintenance

An excellent piece of work is being done by some diesel engine manufacturers and construction equipment makers by sending highly trained service men in the field to instruct contractors' operators and mechanics on correct operation of the equipment, trouble diagnosis, repair and maintenance methods, and on preventive maintenance schedules.

There are also many construction equipment distributors who operate, for the benefit of their customers, well equipped general maintenance plants with auxiliary shops, all manned by expert mechanics. Some of these mechanics are especially trained to service contractors' equipment on the construction sites. These dealers are aware that the economic and efficient performance of the construction equipment which they sell depends on



Diesel powered trench digger in operation. Equipment such as this saves time and labor costs.

sound maintenance and post-sale dealer service.

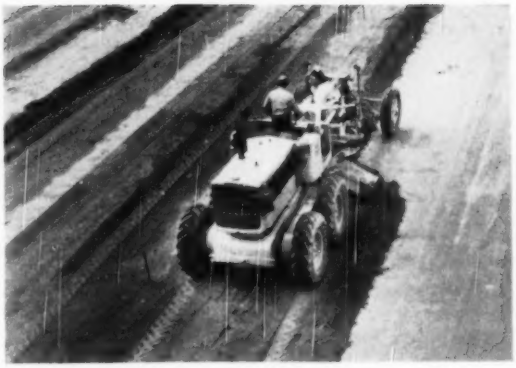
Large contractors usually build at the construction camps complete maintenance shops which can take care of heavy and minor maintenance and repair work.

In constructing these field maintenance shops they have found that it is unwise to store heavy parts on the second floor of these shops. Windows should not restrict the admission of full daylight on the working floor. The equipment entrance doors should be sufficiently large to permit safe clearance of all equipment with its attachments. And the working floor should be higher than the surrounding terrain to prevent dampness and flooding.

Minor repairs to construction equipment are frequently made in the field by the contractor's expert mechanics who are provided with compact repairmobiles. Other vehicles service their equipment with fuel and lubricants.

One large mid-western contractor uses portable maintenance shops, and spare parts trailers, which are moved from job to job. The parts department trailers are always parked next to the portable maintenance shop building on the construction camp site.

To speed-up maintenance work, and to reduce repair costs, one firm uses an incentive maintenance plan which provides a premium for increased productivity. This firm claims that they have doubled their productivity; or, to put this another way, it has reduced its maintenance crew by 50 per cent.



Caterpillar diesel No. 12 motor grader working material on the Hollywood Freeway preparing for paving.

Some contractors do their heavy maintenance work on construction equipment during the winter so that they can increase their summer profits.

The field maintenance men of some contractors make minor repairs to the equipment during the lunch hour of the construction workers so that there is a minimum loss due to non-productive labor costs.

Since there is usually plenty of dirt attached to construction equipment the first step in general overhauling in large contractors' shops is to pre-soak the diesel engines, or diesel engine parts, in a cleaning compound. Next the sand, grit, grease, tar and dirt are removed with high pressure steam and water treatments. This enables the contractors' maintenance mechanics to make a more thorough inspection of all parts. After the repairs have been made, and the engines reassembled, they are given a protective coating for corrosion arresting purposes.

Preventive Maintenance Schedules

The preventive maintenance schedules for construction equipment cannot be standardized like the equipment of railroads which operate under virtually the same conditions at all times. The maintenance schedules of two contractors are not the same because the schedule of each depends on the climate, terrain, kind of work, hours of usage, and abuse of operators. Because of severe operating conditions on some jobs, some contractors find it necessary to completely overhaul their diesel engines every 1000 hours of operation.

Some contractors' maintenance policies consist of daily inspection and servicing; unit maintenance such as motor adjustments, and the replacement of worn parts or defective assemblies; and major overhauls.

On the other hand some contractors schedule their motor graders, cranes, shovels, motor carryall scrapers, tractors, draglines, rollers and trucks for a definite amount of maintenance inspection and service after each 60 hours of operation.

From all of this one can see that diesels have made great progress in the construction equipment field during the past twelve years. And in the future diesel engines will be used more extensively in the construction industry because of their low cost of operation and maintenance.

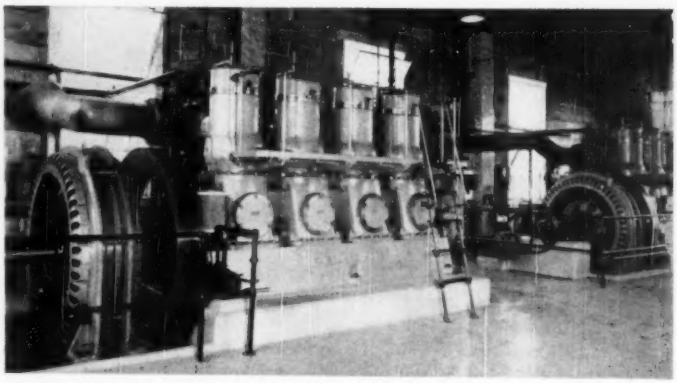
Diesel shovel loading gravel from a glacial moraine. The material was to be used to raise the grad of a pioneer road in the vicinity of Bear Creek as part of the Alkan Highway project.

A Quarter Century of Profitable Operation

THEORETICAL calculation and laboratory tests can yield a lot of valuable information about a piece of power equipment. Economists and business analysts can make interesting and informed predictions on power plant financial operations and profits. But laboratories cannot reproduce fully the operating conditions in the field and economists are not infallible. In the final analysis, the true testing ground of engine performance and plant success is the field installation, not necessarily the glossy new plant just put on the line, but the old plant where veteran engines have been carrying the load for a long, long time.

That is why this reporter likes to visit plants like the Woodsfield, Ohio, municipal power station where Fairbanks-Morse diesels have been supplying all electric light and power needs for more than a quarter of a century. This community of 2500 population, like so many other small towns, is more concerned with meeting today's power needs than with the preservation of historical records, but the data is there for anyone who cares to dig. Superintendent L. W. Marple and City Clerk Harold Cline can produce the yellowing records on plant performance while the files of the weekly newspaper provide annual financial reports. The end result is a picture of a plant that has run long and efficiently, providing unfailing service and a substantial profit.

Actually, your reporter confesses he gave up the search after working back to 1929, but that affords us a revealing 20-year span. In those 20 years, Woodsfield's engines ran a total of 233,338 engine hours and generated 22,310,400 kwh. In those 20 years, the total income of the electric department was $623,542.22 and total expenditures were $423,279.31, leaving an operating profit of $200,262.91. In addition, the plant is completely free of debt and on Dec. 31, 1948, the electric department had a cash balance of $38,233.13. In the entire history of the plant, Mr. Marple reports, there has never been a single interruption of service due to engine failure.



Two of the Fairbanks-Morse 4-cyl., 14 x 17 diesels installed in 1945 and 1947, respectively, in the Woodsfield, Ohio, municipal plant.

Engines

Woodsfield also illustrates the steady improvement in diesel engines. The town's first internal combustion engines, put into service in 1923, were two identical Fairbanks-Morse semi-diesels, each rated at 200 hp. By modern standards, their production of less than 10 kwh./gal. is hardly impressive, but they carried the load for more than ten years and consistently made money for the town. The next installation, in 1933, was a 5-cyl. Fairbanks-Morse diesel developing 350 hp. The efficiency of the full diesel cycle improved fuel consumption. This engine was later modernized with enhanced efficiency and a power rating of 375 hp. at 300 rpm.

As soon after the last war as they could obtain an engine, Woodsfield purchased a four-cylinder, 14 x 17-in., Model 32E14 Fairbanks-Morse diesel rated at 300 hp. at 300 rpm. This unit was put into service in September, 1945. Latest addition to the generating equipment is another F-M diesel of the same model and size, put on the line in September, 1947. The original engines were removed from the plant and sold for service elsewhere. With the modern engines in full production, the plant effected notable improvements in fuel economy. Here is the way efficiency improved in the last five years:

Year	*Kwh. Generated*	*Fuel Consumed*	*Kwh./gal. Fuel*
1944	1,157,500	111,243	10.40
1945	1,195,000	96,460	12.38
1946	1,412,500	113,180	12.48
1947	1,587,500	125,650	12.63
1948	1,842,000	144,400	12.75

The plant's oldest unit, now in its 17th year of service, averages a good 12.25 kwh. per gal.

To achieve a plant average of 12.75, it is clear that Mr. Marple has the three essential ingredients: good prime movers, good accessory equipment, and sound operating practice.

All the engines are two stroke, crankcase scavenging, mechanical-injection diesels designed for heavy duty at the moderate speed of 300 rpm. Each engine drives directly a 3-phase, 60-cycle, 2400 volt Fairbanks-Morse alternator, 232.4 kw. for the 5-cylinder engine and 200-kw. for each of the others. As far back as December 1947, peak loads ran up as high as 470 kw. and it is sometimes necessary to run all three diesels to carry the load. This puts a premium on engine dependability and orderly maintenance.

Maintenance

Mr. Marple and his operators pull pistons once a year for a complete inspection and servicing. They find rings free and cylinder and bearing wear small. They have, upon occasion, taken up a connecting rod bearing but never a main bearing. Regular maintenance pays off and the superintendent can report he never has had a serious repair and never has had to take the plant off the line because of engine failure.

Other Equipment

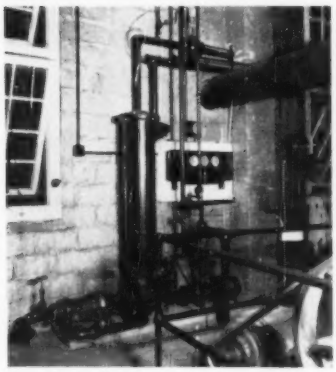
Another factor in this record is the careful handling of fuel, lube and cooling water. Only treated spring water is used in the closed cooling circuit with a Fairbanks-Morse centrifugal pump for each engine circulating the water through the engine jackets and individual Sims heat exchanger. Another trio of motor-driven F-M centrifugals draws raw water from a reservoir and puts it through the exchangers and over an atmospheric cooling tower. A Fulton Sylphon automatic control valve for each engine bypasses enough raw water around the exchangers to maintain a jacket temperature of 136 deg. F.

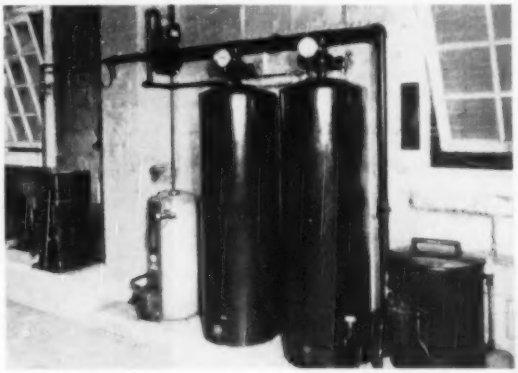
The plant uses a No. 3 diesel fuel which is brought in by truck and unloaded by a motor-driven F-M centrifugal pump into a 6,000 and a 12,000 gal. storage tank. Fuel is then transferred through Niagara meters to individual 300 gal. day tanks underground near the plant and from this point is drawn through Nugent filters to the diesels by built-in engine supply pumps. There is a Levelometer hydrostatic gauge on each day tank and an alarm that sounds when the tank is full. Fuel injection for each engine is regulated by a Woodward governor.

The Pure Oil Co. lube is cleaned continuously in a Honan-Crane purifier which utilizes a fuller's earth filtration element. Lube is drawn from the crankcases of the No. 2 and No. 3 engines, put through the purifier and returned to the engines. There are additional filters on each engine.

Scavenging air is drawn into the crankcase through twin Burgess air filters mounted on each engine. Exhaust gases for the two latest units vent through vertical Burgess snubbers outside the plant. The old diesel utilizes an expansion pit and simple stack. A compact alarm panel near each engine holds gauges and alarms on jacket water temperature and pressure and on raw water pressure. Two Brown pyrometers permit a check on exhaust temperature at each cylinder of all three engines. Starting air for the diesels is supplied by a Fairbanks-Morse compressor which can be belted to either an electric motor or a gasoline engine.

Another operating aid is the well-equipped 8-panel switchboard which holds Roller-Smith meters, General Electric vibrating contact voltage regulator, synchronizer, and electro-static ground detector, Bristol recording voltmeter, Sangamo totalizing kw. meter, Condit circuit breakers, and Telechron master clock.





(Left) F-M centrifugal pump circulates cooling water through engine jackets and Sims heat exchanger (center). Note Fulton-Sylphon regulating valve at top center. (right) Lube treating and starting air equipment. Lube is cleaned continuously in Honan-Crane purifier.

Finances

In 20 years, labor cost a total of $160,992.50, fuel cost $177,855.42, maintenance and repair of buildings, machinery and lines $44,385.56, lube, supplies, office and miscellaneous $40,045.83, making a total operating cost of $423,279.31. Subtract this figure from the receipts of $623,542.22 and we get the operating profit of $200,262.91.

Of this sum, $80,702.91 was spent on new equipment and the rest either turned over to the city or put into the current cash reserve. As a result, not only is the plant debt-free with a comfortable cash balance to meet future needs, but it has made large contributions for the construction of the waterworks, the sewage system, parks and other civic improvements. In addition, free power is provided for water pumping, street lighting and city offices.

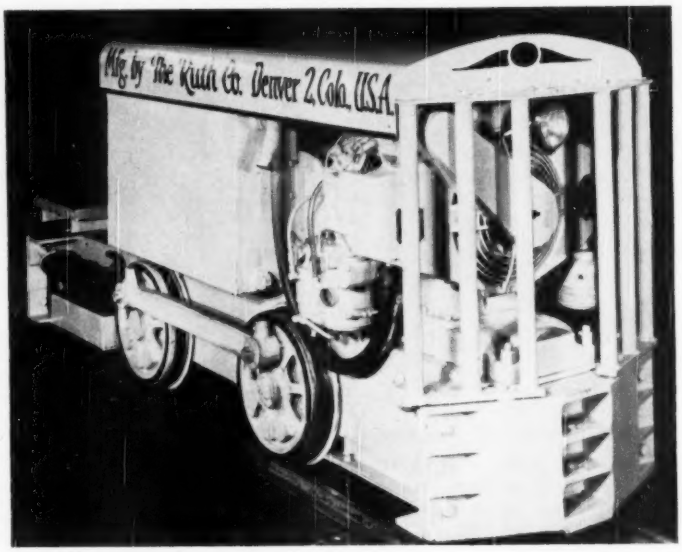
The electric department is run by Mr. Marple under the supervision of a Board of Public Affairs. Major policy matters are passed on by the Mayor and the 6-man city council.

Only the rough stone exterior labels this an old plant. Inside, Woodsfield has an efficient, attractive, thoroughly modern power station of sound basic design. There is good reason to believe it will still be producing power with equal or greater efficiency a quarter century from now.

Two-Ton Trammer Uses Air Cooled Diesel

OVERALL heights of diesel mine locomotives generally have been limited to the height of the engine. A new 2-ton trammer produced by the Ruth Company has overcome this limitation by the use of a horizontal 2-cyl. air-cooled Onan diesel engine. The result is a very low silhouetted unit wherein the driving mechanism dimensions are now the limiting factor.

Complete satisfaction with the power unit has been expressed and because of the reliability and economy of operation, considerable savings have been effected in comparison to other types of haulage. Typical economies reported for slightly larger units are a saving of $0.15 per ton over former haulage costs; another, $85.00 per day on two shift operation; still another, pulling 300 ton per day from one mile underground using only seven gallons of diesel fuel.



The new trammer manufactured by Ruth which uses the horizontal 2-cylinder Onan air-cooled diesel. The rectangular "box" on the left is the patented Ruth exhaust gas conditioner.

Frame and Running Gear

To stand up under normal mining operations, trammers must be ruggedly constructed. Rigid and heavy frames are used not only for strength but to improve adhesion. Weight of the frame is supported on alloy steel springs resting directly on the axle housing above the Timken bearings. This avoids overhanging of the axles.

Alloy steel tires are shrunk on counter-balanced steel hearts. The latter are mounted on SAE 3140 steel axles that are turned and ground although power is supplied to a single axle, the use of side-rod drive couples both axles rigidly to insure full tractive effort. The builder prefers this construction to the use of chain drive, pointing out that stretch or flexibility may permit one axle to slip before the other, making locomotive weight only half effective.

In order to avoid the double wear of the rails and brake shoes on the tires, separate braking discs are used. Such wear is becoming quite a factor in view of the increasing speeds in underground haulage. Double opposed asbestos brake block shoes are used in contact with the discs. This arrangement is said to produce only one quarter of the wear and heat created by a single brake when decelerating the same load at the same rate.

Engine

Overall height is kept at a minimum, as mentioned, by the use of a horizontal engine with two opposed cylinders. For this application the rating is 10 hp. Air cooling is one of its features and since this method of cooling is generally associated with light, duty, in other than aircraft engines, the comments of the locomotive builder are interesting.

It is reported that the engineers were completely satisfied that the engine would stand up under the rigors of mine service. An indication of the engine's durability is its use as the prime mover in heavy duty generating sets which operate at high loads in continuous 24-hour a day service. If the engines can operate successfully in this type of service, certainly they will perform satisfactorily in mine locomotive service.

General arrangement of the engine is conventional for units of this type although the incorporation of the diesel principle is unusual. The crankcase and cylinders are cast integrally of high strength alloy iron. Opposed cylinder construction is desirable in a two-cylinder engine since the reciprocating forces cancel out to give a unit that has inherent balance.

A short two-throw counterbalanced crankshaft is centrally mounted in the crankcase with the cam shaft above it. Cams operate the valves necessary for 4-cycle operation and the fuel injection pumps. The governor is incorporated with the camshaft gear.

Variable inlet type injection pumps of Demco manufacture mount horizontally, adjacent to the camshaft, and are actuated by cam followers. Differential pintle type nozzles mounted in the heads complete the injection equipment.

Cylinder heads are of cast iron and in addition to the nozzles, house the valves and their gear. Oil bath air cleaners attach directly to the porting of the cylinders.

An axial type fan is mounted on the end of the crankshaft to supply cooling air. A cast aluminum blower housing directs the air flow to the cylinders and heads. A spray of oil on the underside of the piston head also serves to keep piston temperatures the same as in a water-cooled engine.

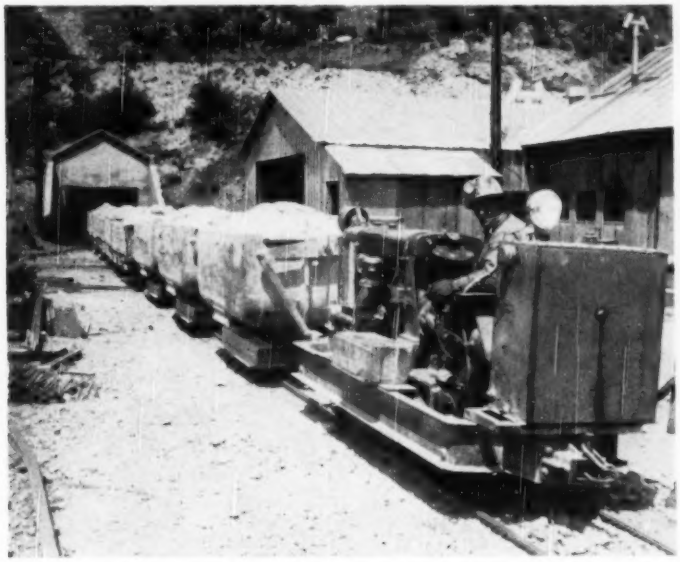
A gear type oil pump provides oil under pressure to lubricate crankshaft and con rod bearings and supply oil to the spray nozzles for piston cooling. Fuel and lube filtration have received the same careful attention as air filtration.

Power Train

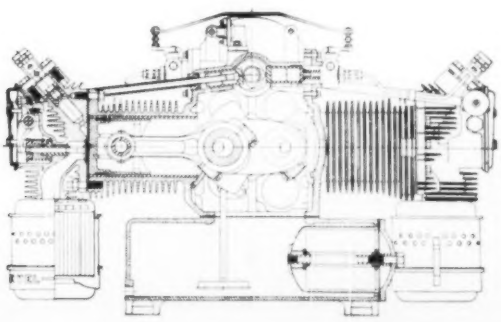
Power is transmitted from the engine through a fluid coupling and gear transmission to the locomotive axle.

A Twin Disc balanced impeller fluid coupling transmits the full torque of the engine when running above 600 rpm. It isolates the engine from shocks inherent in locomotive operation and also protects the gears. For example, a shock resulting from the collision of the locomotive with a string of ore cars can never place a stress on the gears greater than full engine torque. In a rigid system the possible stress is incalculable.

Power is applied to the gears through a Twin Disc 4-plate multi-disc clutch. The alloy steel, heat treated gears are of the helical cut bevel type solidly mounted in Timken bearings. With this combination, the full 300 lb. tractive effort can be applied to the rails as gently or as positively as the operator demands. Speeds up to 6 mph. are attained.



Ruth mine locomotive powered by an upright engine pulling a string of ore cars. Rectangular box at rear of locomotive is the exhaust gas conditioner.



Cross section of a typical Onan-designed horizontal engine.

Exhaust Gas Conditioner

The patented Ruth exhaust gas conditioner is used as in the case of the larger units. It is a stainless steel unit bearing the approval of the various Safety Bureaus and the Chief Mine Inspectors. Aldehydes, oxides of nitrogen, traces of CO and other irritants that are products of diesel combustion are effectively removed. In general, if mine ventilation is sufficient to remove powder gases from blasting there is enough air for diesel underground transportation.

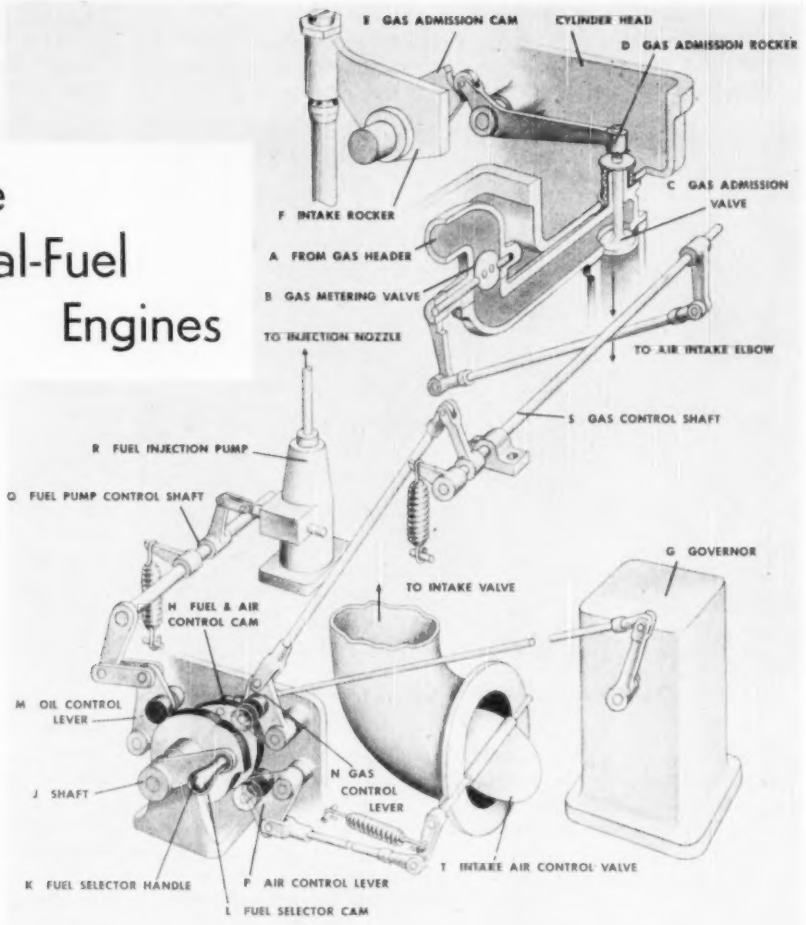
Water must be added to the conditioner after every four hours of operation, the consumption in this period being approximately 10 gal. A chemical is used to neutralize the nitric acid produced by the diesel exhaust. Without the chemical the pH is 3 and with the chemical 6.5 to 7. It also has the effect of making soluble the lube oil carried over by the exhaust and thus eliminates the gummy, sticky mass that forms in the conditioners where the chemical is not used.

Maintenance

Attention has been given to maintenance under the normal conditions of mine locations. The side-rod bronze bushings, for example, can be replaced by the use of a mine vise. It is also possible to adjust the axle bearings with only a crescent wrench and a sharp knife. The Timken bearing adjustment and proper gear mesh are maintained by the use of abutment pins and the use of laminated shims built up in 0.002-in. laminations. Precise adjustment can be made by simply using the knife to peel off the required layers.

Major emphasis with regard to the power train is in the matter of preventative maintenance. This applies principally to the exclusion of abrasive dust and dirt from the scavenging air, fuel and lube systems. Other maintenance of the engine and the components of the drive system is conducted in accordance with the manufacturer's recommendations.

Enterprise Dual-Fuel Engines



The various parts of the Enterprise fuel oil and gas control system. Operation of the system is explained on the following page.

TWO BASIC considerations were kept in mind by the engineers of the Enterprise Engine and Foundry Company during the development of their recently announced dual-fuel engines. These were: The efficient use of gases—natural, manufactured or sewage gas as well as butane or butane-propane mixtures—and ease of convertibility of existing engines to utilize gaseous fuels without dismantling or lengthy shut downs.

The Series DG and DQ diesel engines were used as the basis for the DGSG and DGSQ dual-fuel Series. Both of these are built in 6 and 8-cyl. executions either normally aspirated or turbocharged. The DGSG's have 12-in. bores and 15-in. strokes while the DGSQ's are 16 in. by 20 in. The smaller bore engines have a horsepower range in their various versions from 250 hp. at 250 rpm. to 1230 hp. at 600 rpm. The larger engines run from 500 hp. at 210 rpm. to 1755 at 360 rpm. These ratings, incidentally, are identical to those of corresponding diesel models.

The dual-fuel units are essentially diesel engines with a simplified gas-fuel system with special controls for regulating the quantity of gas admitted to each cylinder. The control system also incorporates a method of intake air control for greater efficiency in the lower load range.

Safety controls that provide positive and automatic shut-off in case of high water temperature, low oil pressure or an overspeed condition are also built in. When shut-down occurs, the gas is cut off before the pilot fuel with the result that the possibility of explosions in the exhaust piping due to accumulations of gas is eliminated.

Operation of a single lever shifts from diesel to dual-fuel operation or back again. The change is effected without noticeable variation in load or speed. Minimum pilot oil requirement is about 5 per cent of the total Btu. input at rated load and is supplied to the cylinders by the regular diesel injection system.

Gas is introduced into the individual air intake elbows where it can mix intimately with the scavenging air prior to compression and combustion. The pressure is controlled by a regulator after which the gas flows into

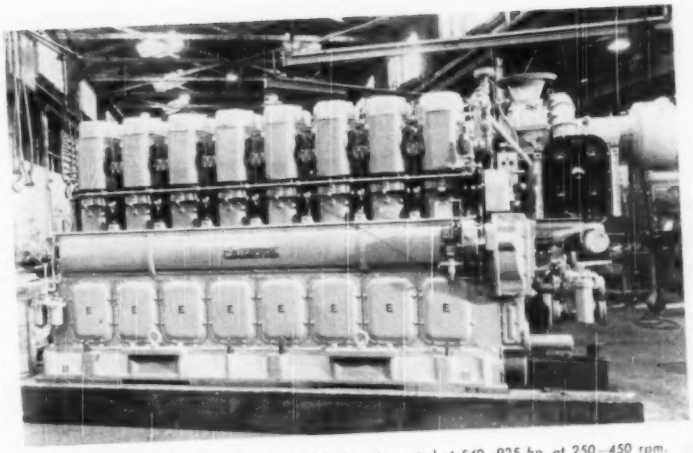
a distribution header running the length of the engine. Connecting piping from the header to the intake elbows contains the metering and admission valves. The first is a butterfly operated by the control linkage with the second, a poppet type valve actuated by a rocker arm and cam. This timing feature is necessary in the case of turbocharged engines to delay gas intake until after the blow-through period and thus avoid waste of gas.

Fuel/air ratios are controlled during dual-fuel operation by the use of a butterfly in the main scavenging air piping. Control is automatically obtained through governor action.

It can be seen that there are three things to control: liquid fuel, gas and air. This is done by a single governor that suitably regulates the quantity of fuel delivered to meet the load condition regardless of the fuel selected for use. Operation of the control system will be explained with reference to the accompanying illustration.

In the position shown, the controls are set for dual-fuel operation. Fuel selection is accomplished by movement of the fuel selector handle (K). A quarter turn counter-clockwise positions the controls for diesel operation.

The terminal shaft of the governor (G) is connected to the fuel and air control cam (H) that floats on shaft (J). The cam rotates in accordance with governor action. Such movement is transmitted to the gas control lever (N) to position the gas control shaft (S) and through linkage, the gas metering valve (B). The air control lever (P) also rides on this cam and during dual-fuel operation is affected by its movement.



Enterprise DGSG–38 8-cyl. 12 x 15 dual fuel engine rated at 540–925 hp. at 250–450 rpm.

Fuel selector cam (L) is fastened to shaft (J) and follows the movement of the handle (K). In the position shown, the oil control lever (M) does not contact cam (H) but is positioned by the fuel selector cam (L) to supply the proper amount of pilot fuel.

For diesel operation, the movement of the fuel selector cam (L) to the left breaks the contact with the oil control lever (M) permitting it to ride on and be moved by the fuel and air control cam (H) in accordance with governor action. At the same time, the contour of the selector cam is such that it will contact the gas control and air control levers (N and P) lifting them clear of the fuel and air control cam (H). When this occurs, the gas metering valve (B) is held closed and the intake air control valve (T) held in the wide open position.

Under all conditions of operation, dangerous overloads are impossible. The control system has been designed so as to prevent the supplying of more than enough fuel, regardless of type, to meet requirements for full load operation.

Dual-fuel engines operate on the diesel cycle and are fully as economical on a Btu. basis as are diesels, providing that they are operating at approximately half load or above. Wherever gaseous fuels are available at a lower cost per Btu. than oil, even on an intermittent basis, such engines as these offer definite economic advantages.

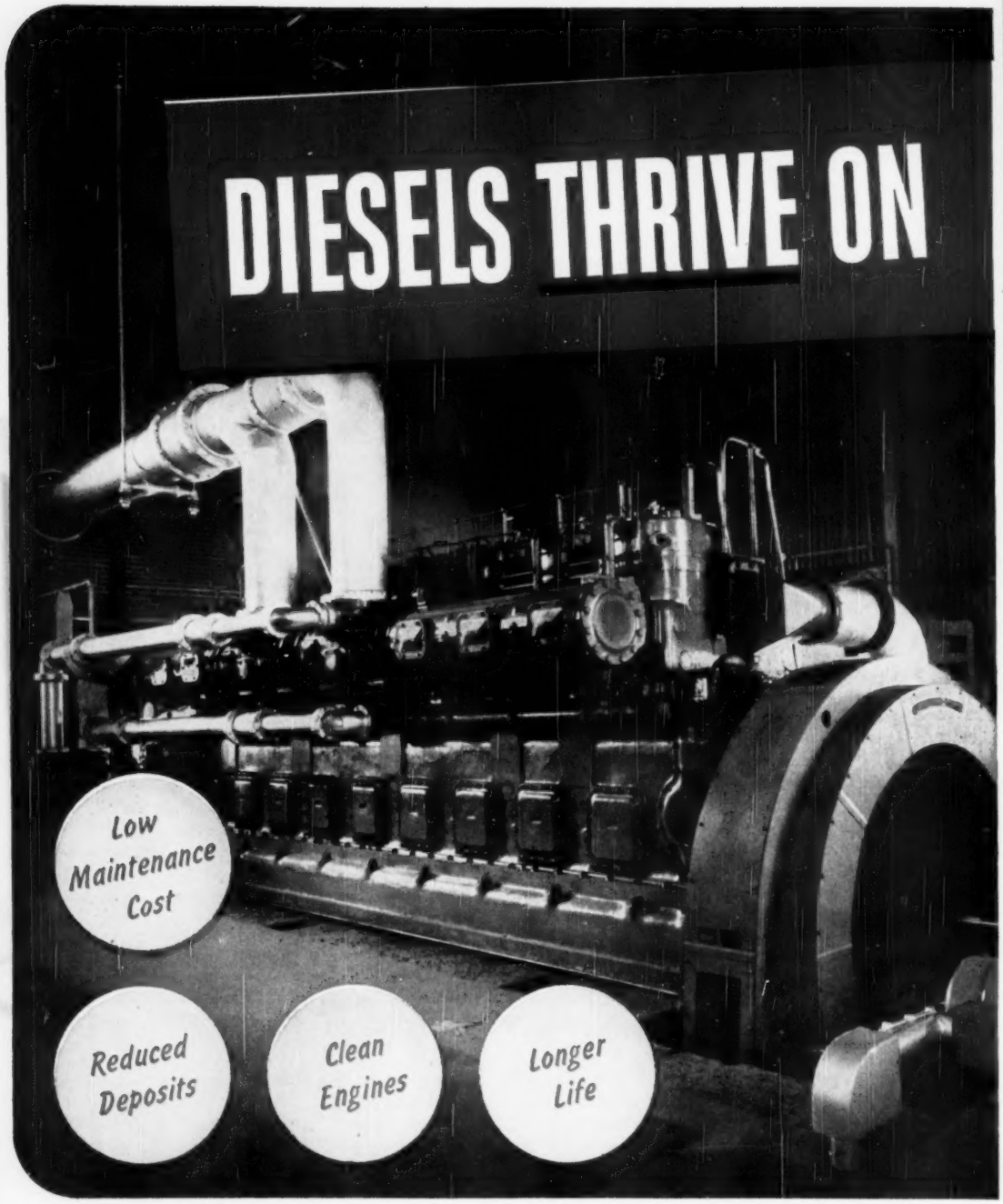
Enterprise Changes Name

Enterprise Engine and Foundry Company has changed its corporate identity to Enterprise Division, General Metals Corporation, with Paul I. Birchard named Vice President and Manager, according to an announcement by William E. Butts, head of Enterprise operations. The change became effective upon the consolidation of Enterprise with two other nationally known manufacturing concerns, Adel Precision Products Company of Burbank, Calif., and General Metals Corporation, with California plants located at Los Angeles and Oakland and a third at Houston, Texas.

Butts, who was named president of the new corporation, also announced that there will be no change in the existing operations or policies of any of the divisions. Enterprise, located at San Francisco, manufactures a wide range of diesel engines, various types of process machinery, in addition to a line of commercial oil burners.

The Adel Division manufactures an extensive line of hydraulic, fuel and de-icing equipment for aircraft in addition to hydraulic control equipment for industry, while the Metals Division is widely known for its foundry work in producing forgings and castings at its various plant locations.

Principal offices of the newly formed consolidation are now located in San Francisco.



A 2,000 hp, 300 rpm Fairbanks-Morse engine in Municipal Light plant, Kennett, Mo., operating on Sinclair Gascon Oil HD.

SINCLAIR

For lubrication counsel, see your nearest

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Is yours an "EASY" operation?

Then use Sinclair Gascon Oils, without additives. If your diesels run free from overloads, repeated peak demands, long idling periods, and free from unusually high, low, or fluctuating cooling water temperatures then Sinclair Gascon Oils are recommended.

Sinclair Gascon Oils have low carbon-forming tendencies. Their natural cleansing action keeps engines clean, promoting full power and low maintenance . . . with economical oil and fuel consumption.

Is yours a "TOUGH" operation?

Then use Sinclair Gascon Oils, HD. If your diesels are subject to repeated or continuous overloads, high jacket and crankcase temperatures, idling periods, then Sinclair Gascon Oils HD should be specified.

These are heavy-duty, additive-type oils with greater cleansing and dispersion action, greater resistance to oxidation. They preclude bearing corrosion and are non-foaming. They keep diesel engines clean despite punishing operating conditions and assure oil, fuel, and maintenance economy.

INDUSTRIAL OILS

Supplier of Sinclair Products or write Sinclair Refining Company, 630 Fifth Avenue, New York 20, N. Y.

Your REA—Its Operation and Program

Typical REA-financed plant of the Border Counties Power Cooperative at Warroad, Minnesota.

THE DIESEL Engine Manufacturers Association and the top officials of the Rural Electrification Administration recently held a joint luncheon in Washington, D. C. during the course of which certain information concerning the REA program was given and a discussion of the plans of the REA held. Mr. James B. McCurley, Chief, Power Division, REA quoted some statistics on the REA operation which should prove to be of interest to men in the diesel field.

In his address, Mr. McCurley said that REA borrowers now have a total of 536 diesel units in operation in the various plants around the country and in Alaska. These 536 units are capable of generating 223,195 kw. representing 73.8 per cent of the total capacity of all REA plants. In addition, several plants are now under construction which will utilize 30 diesel engines having a total capacity of 46,028 kw. and plans have been made for an additional number of plants which will use 29 engines to produce a total capacity of 28,029 kw. These figures are impressive, 59 engines either being installed or planned, and are even more so in view of the fact that 30 of these 59 engines are in the 1300-2700 kw. class.

The REA is now in its 16th year of operation. It was created by Executive Order in May 1935 and statutory provision for the agency was made in the REA act of 1936. REA became a part of the Department of Agriculture in July 1939. It has remained a part of this department since that time but, instead of borrowing funds from the RFC as it originally did, it has been borrowing funds directly from the Treasury ever since this practice was authorized in 1947.

The REA is rather unique among Federal Agencies in that the only money it actually spends goes for salary and administrative expenses involved in running the program. No grants or subsidies are involved. REA lends the entire construction cost of building facilities to provide electric service to rural people who do not have it. Most of its loans have been for distribution facilities. Loans for generating plants are always subsidiary and incidental to the extension of distribution lines, or the maintenance of adequate and dependable service on lines previously financed. All loans must be paid back to the Government with two per cent interest over a maximum period of 35 years.

In making loans for generating and transmission facilities, a field in which REA borrowers have increased their activity during the past two years, the agency adheres strictly to its policy of making such loans only under the following conditions: (1) Where no adequate and dependable source of power is available in the area to meet the borrower's needs, or (2) Where the rates offered by existing power sources would result in a higher cost of power to the borrowers than the cost from facilities financed by REA.

The plan of REA is to provide electrical power to rural areas not served by central power stations. When the program was first started in 1935, it was anticipated that the majority of loan applications would come from commercial utility companies, but when this failed to materialize, the agency turned to cooperatives to carry out its program.

These electric co-ops were organized along the same lines that farmers and other rural people had organized their consumer and marketing co-ops. One of the services provided by the REA now is to guide prospective groups of farmers in forming their cooperative and helping them draft by-laws and a constitution for the efficient operation of their project. The most recent statistics released by the REA show that of the 1067 groups who have borrowed funds from the agency, 977 are cooperatives, 41 public power districts, 24 other public bodies, and 25 are commercial power companies.

Diesel plants operating under the REA program range in capacity from a 10,340 kw. plant down to very small "plants" of less than 50 kw. capacity.

Co-ops building REA-financed power plants retain their own consulting engineers. REA has a staff of engineering specialists who supervise and inspect specifications, installation, and the completed plant and their operation as a safeguard to the Government investment. No contract between an REA borrower and an outside firm, for either services or equipment and supplies, can become effective without REA approval.

A monthly plant operating report is required from all internal combustion electric generating plants. This report is divided into several sections and, when completed, gives the complete

Comparison Operating Data — Certain REA — Financed Diesel Generating Plants

Calendar Year 1949

Plant	Inst'd KW (End of Year)	15 Min. Peak KW	Gross KWH	Net KWH	Man Hours, Operation	Man Hours Maint.	Maint. Material $	Load Factor %	Plant Factor %	Run. Plant Capacity Factor %	Hp-Hrs. Per Gal. Lube	Gross KWH Per Gal. Fuel	Maint. Man-Hours Per KW-YR.	Maint. Material $-KW-1 YR.	Avg. Oper. No.	KW Oper.
1	3,946	3,816	14,791,780	14,102,850	10,808	2,685	3,461.01	44.3	42.8	71.8	3,425	13.40	0.677	0.877	5.0	788
2	3,200	3,800	12,337,870	11,999,030	23,629	313	6,411.99	37.1	44.0	81.1	3,282	13.67	0.098	2.005	10.1	317
3	3,755	1,770	6,493,560	6,070,170	9,656	1,503	513.67	41.9	29.1	67.0	2,199	13.15	0.590(a)	0.198(a)	5.5	472(a)
4	3,685	3,425	13,416,380	12,801,120	17,913	5,415	26,841.79	44.7	41.6	59.7	4,396	12.33	1.468	7.290	10.3	358
5P	760	850	2,553,000	2,422,220	5,202	274	994.66	34.3	38.4	85.4	4,480	13.50	0.361	1.310	3.6	211
6P	1,760	1,925	5,687,590	5,406,260	7,812	1,503	1,427.58	33.7	36.9	66.0	1,878	14.21	0.855	0.811	4.6	383
7P	4,325	4,800	17,271,900	16,602,750	12,020	2,625	10,074.97	41.1	45.6	75.5	3,430	12.91	0.607	2.485	7.1	610
8	4,025	3,800	11,303,300	10,949,130	16,057	6,370	30,302.38	34.0	32.1	60.1	3,433	12.75	1.581	7.530	9.1	443
9P	2,600	2,600	11,795,000	11,353,710	9,714	3,157	3,599.35	51.8	51.8	76.7	2,195	12.89	1.211	1.382	5.8	948
10P	2,600	2,600	7,775,800	7,264,940	9,296	2,627	2,899.11	34.1	34.1	75.9	2,351	13.23	1.015	1.113	5.5	473
11P	2,600	2,600	8,079,000	7,755,710	8,629	1,353	1,482.86	35.5	35.5	72.0	3,504	12.83	0.521	0.571	4.8	542
12	1,000	920	3,865,970	3,707,708	11,616(E)	245(E)	6,434.82	48.0	44.1	58.9	1,906	11.00	0.245	6.435	5.0	200
13	1,900	1,030	4,883,000	4,688,156	12,510(E)	1,498(E)	3,365.03	54.1	29.3	64.9	2,597	11.76	0.787	1.770	6.0	317
14	692	685	1,556,800	1,383,330	5,252	255	19.02	26.0	25.7	61.6	3,115	11.77	0.367	0.027	2.3	301
15	2,441	2,400	7,934,600	7,588,600	7,618	2,190	2,269.55	37.7	37.1	63.6	2,312	11.39	0.897	0.930	3.9	626
16	3,086	3,000	10,447,900	10,104,311	5,582	3,890	9,355.05	39.8	38.6	76.3	2,372	13.74	1.261	3.031	4.0	772
17	3,082	3,450	13,429,400	13,009,300	11,611	1,031	3,392.99	44.4	49.7	81.5	3,305	12.65	0.335	1.100	5.6	551
18	3,475	2,800	10,806,600	10,327,237	11,074	1,824	2,290.04	44.0	35.5	71.0	2,015	14.00	0.525	0.659	5.9	589
19	2,375	1,950	8,174,800	7,691,972	8,820(E)	1,410(E)	5,685.49	47.9	39.3	70.6	2,240	13.44	0.594	2.385	4.0	594
20	3,192	2,300	7,641,610	7,181,400	10,282	449	727.27	37.9	27.3	68.7	2,780	13.85	0.141	0.229	5.0	638
21	4,250	3,700	11,759,030	11,204,760	11,027	9,033	11,645.90	36.3	31.6	73.3	2,575	12.50	2.125	2.740	6.7	634
22	7,250	7,100	25,231,280	24,713,210	17,753	10,599	11,728.79	40.6	38.4	78.7	2,225	13.68	1.412	1.565	10.7	701
23	3,200	3,000	9,196,500	8,823,805	6,989	6,250	3,869.69	34.9	32.8	73.9	1,890	13.00	1.951	1.205	5.0	640
24	3,885	2,175	7,131,795	6,708,909	10,059	1,685	1,705.74	37.4	25.8	58.9	5,074	13.01	0.534	0.540	4.4	718
25	2,016	1,170	4,103,093	3,586,611	15,530	1,373	940.91	40.0	22.2	69.2	2,076	12.19	0.682	0.467	6.3	320
26	10,840	11,300	29,849,600	29,099,600	20,595	7,950	4,286.81	30.2	31.4	77.6	2,297	14.00	0.993(a)	0.536(a)	12.5	641(a)
27	4,800	4,800	14,248,000	13,729,400	12,474	645	1,407.02	33.9	33.9	47.7	5,456	12.33	0.134	0.293	5.7	842
28	5,090	3,800	17,732,800	17,174,800	19,823	3,262	5,677.27	53.3	39.8	73.6	3,304	13.65	0.641	1.115	10.0	509
29*	2,478	1,400	5,022,132	4,766,443	11,098	1,388	4,117.85	41.0	28.2	64.8	2,744	13.75	0.682(a)	2.020(a)	5.8	351(a)
30*	4,230	2,480	4,810,858	4,581,738	5,873	1,242	2,439.86	53.1	33.8	69.6	1,855	13.48	0.682	1.380	7.8	499
31P	4,200	4,200	99,830,400	9,538,108	15,678	4,032	6,475.02	26.17	26.7	81.5	4,150	13.45	0.961	1.541	10.7	392
32P	5,000	5,000	3,950,200	3,770,870	12,895	1,230	1,769.82	9.0	9.0	66.6	4,210	13.85	0.246	0.354	8.0	625
Totals	111,738	100,646	23,113,548	310,108,158	364,440	89,306	177,613.31	....	....	....	.....	.....	.....	.....	....	....
Avgs.	3,492	3,145	10,097,298	9,690,879	11,389	2,791	5,550.42	39.0	35.1	70.1	2,971	13.04	0.787	1.747	6.5	516
Cals. on Totals 1948 Total	101,452	86,555	276,125,756	265,213,636	349,474	82,776	99,178.36	36.7					0.799	1.589	180.8	537
Average Cal. or Avg.	3,170	2,705	8,628,930	8,287,926	10,921	2,587	3,099.32	38.2 36.3	34.0 31.0	70.6	3,172	13.14	0.907 0.816	1.23 0.98	5.7	550 561

* Reports for only six months operation.

E Estimated—reported data filled in with estimates as necessary.

(a) Adjusted—to allow for addition of capacity or plant energized during year.

P Peaking plant.

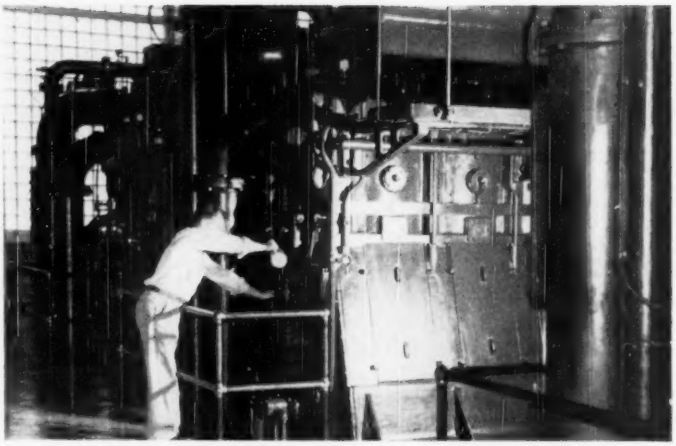
picture of the operating record of the diesel plant for the month. Such items as load and plant factor, maximum demand, expenses of fuel, lube, maintennace and labor, and plant load curves are included in the report. These reports are received by the REA at Washington and studied to determine operational trends. Each year data from these reports becomes a part of various statistical summaries.

The agency has compiled a table of "Comparison Operating Data" for certain REA-financed diesel generating plants which indicates the total installed kilowatts, 15 minute peak kw., net kwh., man hours operated, man hours required for maintenance, cost of maintenance materials, load factor, plant factor, running plant capacity factor, hp.-hrs. per gallon of lube, gross kwh. per gal. of lube, maintenance man-hours per kw. per year, maintenance material cost per kw. per year and several other items. Of the 32 plants included in the tabulation, the gross kwh. per gallon of fuel ranged from a low of 11.00 to a high of 14.21 with an average of 13.04 kwh. per gallon of fuel.

Other averages showed 2,971 hp.-hrs. per gallon of lube oil, 0.787 maintenance man hours per kw. per year, and maintenance material costs of $1.747 per kilowatt per year.

The largest REA-financed diesel installation consists of 6 Cooper-Bessemer and 5 Fairbanks-Morse engines. Three of the six engines are rated at 720 kw., three at 1000 kw., and the five at 1136 kw. The plant produces 14.00 gross kwh. per gallon of fuel at a load factor of 30.2 per cent. In 1949, $4,286.81 was spent on maintenance materials and 0.993 maintenance man-hours per kw. per year were devoted to this part of the operation. The plant produced 29,349,600 gross kwh. in the year.

In addition to providing what amounts to a consulting service for its borrowers, the REA also conducts conferences for the power plant operators in the various parts of the country. One of these was held recently in St. Louis, Missouri from June 6 to June 9. At the conference, which was attended by plant operators from all over the country, various speakers representing



(above) Part of the engine room of the Chippewa Falls plant of the Dairyland Power Cooperative, LaCrosse, Wisc., and (below) workman inspecting valve mechanism on a Worthington engine in the Vestaburg plant of the Wolverine Electric Cooperative, Inc. of Big Rapids, Mich.

manufacturers in the diesel field spoke. Among those speaking was G. L. Baker of Nordberg Manufacturing Company, who spoke on "Development of the Diesel Engine"; E. R. Rawlins, Cooper-Bessemer Corporation, "Lube Oil Maintenance"; George Steven, Worthington Pump and Machinery Corporation, "Fuel Systems of Diesel Plants" and E. E. Wolter, Manager, Rural Cooperative Power Association, "Merits of Scheduled Overhaul vs. Overhaul on Breakdown". Many other persons gave talks on various subjects of interest to power plant operators.

The conference also included inspection trips to two cooperative generating plants and to the plant of the Busch-Sulzer division of Nordberg in St. Louis. It is conferences such as these which stimulate interest of the operators in efficient operation and also enable the representatives of the diesel industry to get their story across to the operators.

As has been mentioned before, diesels account for 73.8 per cent of installed REA power but steam and hydro plants now under construction will have a capacity of 150,420 kw. and loans approved for steam plants not under construction will provide another 264,500 kw. When the program which is now planned has been completed, steam will account for 58 per cent of the total capacity, diesel power for 37.3 per cent and hydro power 4.7 per cent of the total REA capacity.

Chicago Trade Fair

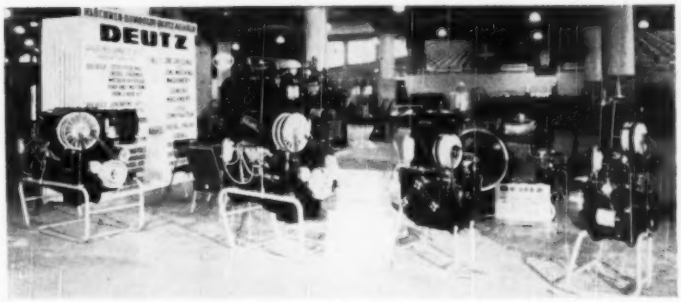
THE FIRST United States International Trade Fair was held in Chicago August 7th to 20th. Several diesel engine manufacturers were represented at the exhibition, among them Burmeister and Wain, ABOE, and Deutz.

The ABOE exhibit was located in the International Amphitheatre and was designed and built in England especially for the Fair. Included in the ABOE exhibit which is shown on this page were several Petter engines of different models, a Meadows engine, Petter Fielding engine and a National engine. Arrangements of the engines to drive generators and pumps were also included in the exhibit.

Burmeister & Wain's exhibit created considerable interest due to the unusual design of the stand. As shown in the photo, the exhibit included many models of ships and engines which are in operation in many parts of the world. In addition, the exhibit included a map of the world showing the more than 40 countries where the small B & W Alpha Diesel engine is in operation. The engine, which was primarily designed for fishing boats and small tugs, was shown in a fire red model one-fifth actual size. The model can be seen in the center of the exhibit.

The Deutz exhibit included engine models of the air-cooled engine which is available in 1, 2, 3, 4, 6 or 8 cylinders rated from 10 to 170 hp. Several other models were also included in the exhibit which can be seen in the illustration. The Deutz engine was recently introduced in this country and the American firm handling the engine is the Diesel Dynamics Corporation of New York.

The trade fair was held in four of Chicago's exposition halls and was devoted to increasing international trade. The Fair included products created by some 130 industries and representatives of more than 40 countries attended the Fair and had exhibitions there.



The Deutz engine exhibit. In the foreground can be seen, from left to right, the various executions of the basic engine which are available.

(above) The ABOE exhibit showing a McLaren engine (left) and three Petter engines. (below) The Burmeister & Wain exhibit at the show. In the center can be seen the model of the B & W Alpha which is one-fifth actual size.

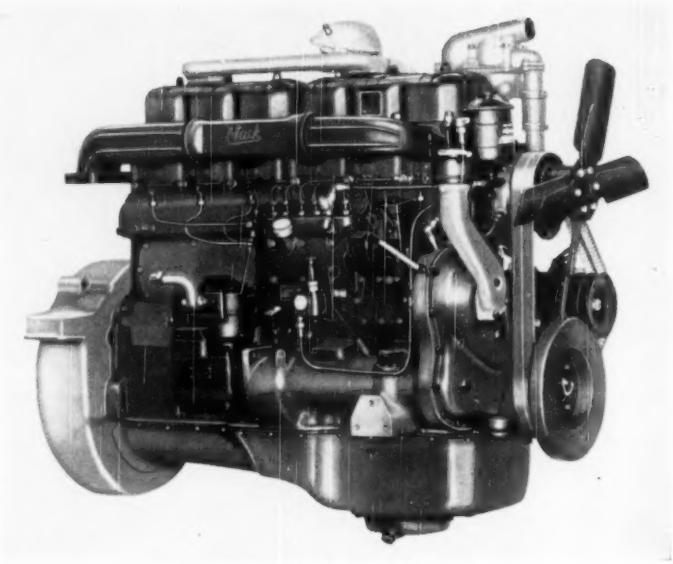
Maintenance of Automotive Diesels

HAVE YOU ever spent a lot of time making something and then have the person who uses it abuse and neglect it so that all your work is eventually wasted? Well, if you have, then you can imagine how a diesel engine manufacturer feels when he sees one of his engines being overloaded and neglected from a maintenance standpoint so that engine life is drastically shortened.

Most diesel engine manufacturers have spent a great deal of time and money in developing and manufacturing a piece of precision machinery that will meet the requirements of performance in the service for which it was designed. This, provided that the engine is given reasonable care and attention. You cannot expect a manufacturer to build an engine that will operate satisfactorily when it is abused and not given proper lube and fuel oil and when maintenance is ignored and neglected.

Although diesel engines are built to stand a certain amount of punishment, the engines, as every reader should know, will not perform well for long periods of time if they are not properly maintained. Engine maintenance does not vary in basic principles from engine to engine, the basic tenets holding if the engine is a small auxiliary or a 3,000-hp. prime mover. In view of the great number of automotive engines currently going into service, this article will deal with preventive maintenance practices recommended for automotive type engines, using the Mack diesel engine as an example.

Essentially, Mack manufactures two diesel engine models, the END 510 and the END 672. Both engines can be used for trucks or buses, the principle difference between them being the piston displacement and the horsepower ratings. The END 510 is rated at 138 hp. continuous at 2400 rpm. and the END 672 is rated at 165 hp. continuous at 2000 rpm. The Mack diesel engine is a six cylinder, four cycle, overhead valve design. The END 510 has a bore and stroke of 4-7/16 by 5½ in. and the END 672 is 4⅞ by 6 in.



The Mack END 672 used in both trucks and buses.

Preventive Maintenance

Truck and bus engines present some unique preventive maintenance problems not encountered in the larger stationary and marine diesel engines. These problems are engendered partly because of the high speeds at which these automotive engines operate and also because of the almost constantly varying conditions of load and speed encountered in operation.

Another factor which adds to the importance of proper maintenance is the fact that the engines do not run continuously for long periods of time and, therefore, are subject to certain conditions which do not exist in stationary installations. Also, truck and bus engines are subject to temperature extremes not often encountered by stationary engines because they are forced to operate on highways in both winter and summer and thus are at the mercy of the weatherman. The use of the automatic radiator shutter has eliminated this problem in the past few years.

The principal objective of any maintenance program should be to establish good performance records and keep the engines operating for long periods of time without difficulty. A good maintenance program should be one that is preventive; that is, one that stops trouble before it starts or, failing that, discovers faulty parts or poor operation before the situation has had time to develop into a serious part failure.

Most successful preventive maintenance programs incorporate regular programs of inspection to enable the maintenance men to check the engine before trouble becomes serious. To accomplish this, many shops use a check sheet with inspections broken down by time periods, v.g. weekly, monthly, quarterly, semi-annually, and annually; by miles, v.g. 1,000, 5,000, 10,000 etc.; by hours, v.g. 500, 1,000, etc.; or by fuel consumption, depending on the service in which the vehicle is used. Probably the best program to follow is a fuel consumption schedule but it is up to the operator to make the final decision.

The short period inspections will, of

course, be far less comprehensive than the longer period checks. The longest period inspection will usually involve major overhaul or complete disassembly and inspection of all major parts of the engine. The shorter period inspections will only involve "hitting the highlights" of the engine to see that the most important parts are in good operating condition.

A preventive inspection program can be set up with relative ease by any intelligent person who has been working on or with engines long enough to have become familiar with trouble spots and who knows the most likely spots where trouble will develop. A top notch mechanic can set up such a program easily and, certainly, anyone who has risen to become a shop foreman should be able to set up such a program.

Getting down to the actual preventive maintenance procedures to be followed, the first thing to bear in mind is that the chief enemy of a diesel engine, or any other mechanism, is dirt. The problem then is how to eliminate this cause of many engine troubles. To do this, we must first determine how dirt can get into an engine.

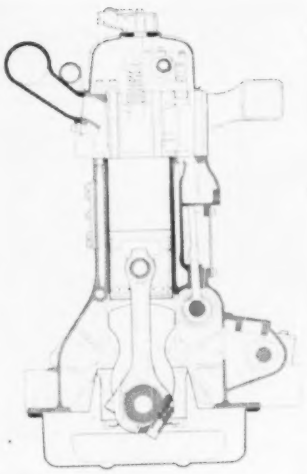
There are four ways that dirt can enter an engine. These are:

1. Dirt or other impurities left in the engine at the time of manufacture or overhaul.
2. Dirt entering through the air intake.
3. Dirt entering through the fuel tank.
4. Dirt entering through the lube oil system.

A little thought about the above four items will show that they sum up the methods by which dirt can enter the engine.

As regards dirt left in the engines at the time of manufacture, this can be pretty well written off because almost all manufacturers follow a policy of testing and flushing the engines after they are completed, disassembling them for inspection and then reassembling them and running them once again. Cleanliness is the watchword in these operations and, as a result, dirt and other matter is eliminated from the new engine.

Dirt entering the engine at the time of overhaul is the fault of the maintenance shop. A good maintenance shop is kept clean at all times and the shop foreman will see that his men do not handle clean parts when their hands or clothes are dirty, thereby eliminating the possibility of dirty parts being put back into the engine after overhaul.



Section through the END 672 at the piston.

In regard to stopping dirt from entering through the fuel, lube or air intakes, let's take a look at the maintenance practices recommended by Mack for the filters on these three systems.

Air Cleaner

The air cleaner is of the self-washing, oil bath type. To service the cleaner, fill the cup to the level mark with SAE 30 engine oil in warm weather and SAE 20 in colder climates. When temperatures are consistently below 20 deg. F. use SAE 10. Empty the cup and refill when oil becomes thick or when the oil reservoir is one-quarter full of dirt. Check all connections from the air cleaner to the inlet manifold for tightness and possibly air leaks.

The frequency of servicing the cleaner depends upon the severity of dirt conditions. Under the worst conditions, the cleaner may require daily servicing. For this reason, the cup should be inspected regularly until the operator is able to set up a servicing schedule based on operating hours or miles and follow this schedule.

Fuel Filters

A primary and secondary fuel filter are included in the fuel system of the Mack engine for the purpose of cleaning all foreign matter from the system. Foreign matter in the injection system can "raise cain" with the delicate mechanisms in the system and cause a lot of trouble for the operator, both in performance and in repair bills. An ounce of prevention in this case is certainly worth the proverbial pound of cure.

The primary filter is a manually-operated, self-cleaning metal edge type of filter. There is no element or cartridge to be changed. The element has a perforated metal shell wound with wire spaced at 0.002 in. intervals. A metal knife is revolved around the element to remove dirt which then sumps to the bottom of the filter and is removed through a drain plug.

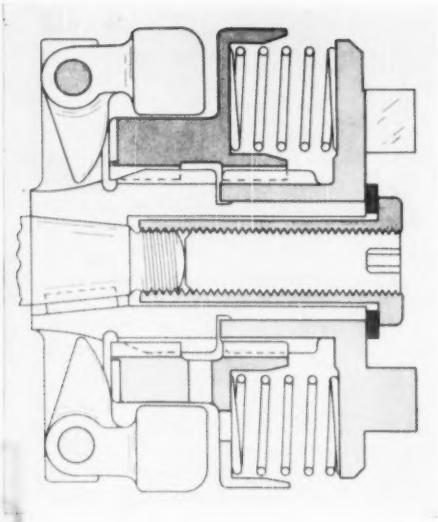
At regular intervals, the cap nut on the filter should be removed and the shaft connected to the scraper knife turned one complete revolution to scrape the element and allow the accumulated dirt and other matter to sump to the bottom of the filter. Depending on operating conditions and the fuel source, the drain plug at the bottom of the filter should be removed and the water and accumulated sediment removed from the filter.

The secondary filter is a replaceable element type designed to remove any foreign matter that has passed through the primary filter and to allow no matter above 5 micron size to pass to the fuel system. The element should be replaced at approximately 4000-mile intervals.

The element is replaced by removing the drain plug from the filter case and draining. The filter case cover is removed and the filter element is removed and discarded. The filter sump should be washed with clean oil and then the element and cover replaced along with a new cover gasket.

Lube Oil Filter

The lube oil filter varies with the type of engine and is either of the strainer type or the replaceable ele-



The Mack synchrovance which provides a variable angle coupling between the injection pump and injection pump drive.

ment type. The same method of servicing applies to these filters as was described in the discussion of the primary and secondary filters but the interval when the strainer type should be scraped is recommended by Mack at 1,500 to 2,000 miles or 50 hours of operation for off-the-road service. The replaceable element filters should be replaced with each oil change to insure maximum lube oil cleanliness.

The important thing to remember regarding both fuel and lube oil filters is to check the filters whenever possible and certainly on a regular schedule. See that they are kept reasonably clean and free of dirt and other impurities. Replace the filters whenever necessary, following the manufacturer's instructions or, if you have a special problem, have one of the representatives of the filter or engine manufacturer advise you on a schedule of filter replacement so that you can get the best performance from your engine.

Injection System

The Bosch injection system can be broken down into three parts, the injection nozzles, injection pump and the fuel supply pump. Maintaining the injection equipment is relatively simple and can be done in any well-equipped maintenance shop. However, repair of the injection system is another matter and calls for specialized tools and knowledge. The best procedure to follow regarding this equipment is to leave it alone if you don't know exactly what you're doing and turn it over to a qualified injection equipment repair shop having the necessary special tools or to one of the service outlets of the injection equipment manufacturer. The equipment costs a good deal of money and a mistake in handling or repairing it can prove to be very costly.

In regard to the injection nozzle, when adjustment is needed, the spring pressure should not be disturbed unless proper test equipment is available for specified nozzle opening pressure. Before testing the nozzle for opening pressure, leaks or spray pattern characteristics, clean the end of the valve body and the protruding end of the pintle with a brass wire brush. When adjustment is necessary, remove the protection cap, loosen the locknut and turn the adjusting screw clockwise to raise the opening pressure or counter-clockwise to lower the opening pressure.

In adjusting the injection pump, a test stand is needed. Again, it is necessary to have the proper equipment and knowledge before attempting adjustments to avoid expensive replacement of parts damaged by improper practices.

The fuel supply pump, mounted on the injection pump, can be tested if a test stand is part of the shop equipment. The pump is connected to the test stand and run at a specified rpm. then checked to see that it is supplying the proper amount of fuel at the correct pressure. A fifteen-second delivery test should also be run at specified injection pump speeds.

In the Mack diesel there is a variable-angle coupling between the injection pump and its drive, which automatically advances the timing of the injection pump as the engine speed increases. This automatic advance causes injection to occur precisely at the moment required for maximum performance. The coupling is called the synchrovance.

Since the advance characteristics must be absolutely correct for maximum engine performance, the mechanism must be returned to the factory for calibration if it becomes faulty.

The injection pump drive layout. Note the synchrovance as it appears in the complete unit.

The Mack organization has an exchange program set up for this component.

Governor

Another engine auxiliary which is included in the parts exchange program set up by the company is the hydraulic governor. Special tools are necessary to repair this mechanism and the investment necessary to obtain these tools is not warranted for the average size maintenance shop. It would not pay the average fleet owner, operator or service station to train personnel and make the necessary investment. An old governor can be replaced with a rebuilt unit for approximately 25 per cent of the price of a new one.

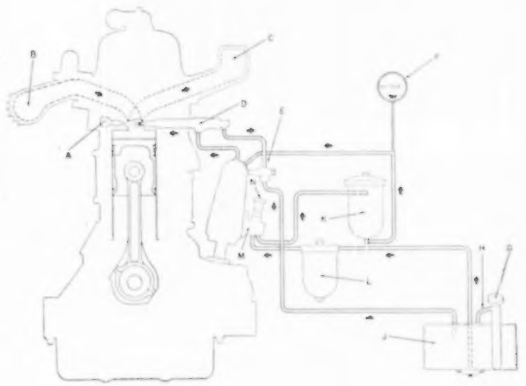
Head Studs

Cylinder head studs torque should be rechecked at 1,500 miles and retightened as necessary. Head studs should be tightened in proper sequence according to the manufacturer's specifications and the use of a torque wrench is necessary. This is required to prevent undue stress being put on the studs. The practice of overtightening studs is bad because it will stretch the head and will cause early failure of these studs. Over-tightening may also cause warping of the cylinder head and deformation of the top surface of the block around the studs.

Valves

Whenever studs are tightened, valves must be readjusted because the tightening operation compresses the cylinder head gasket which, in turn, will affect clearance between the end of the valve stem and the rocker arms. Check the manufacturer's maintenance manual for the proper clearances and final check these clearances on a hot engine. Valve clearance must always be present, since no clearance will result in valves being held open, which not only causes valve damage, but camshaft and lifter damage as well.

Generally, the major problems that are encountered in diesel valves are breakage, seat wear, valve face guttering, stem and guide wear, and sticking. The operator can, by proper maintenance and operation prevent these causes of valve problems provided that the valves are properly designed and made. Another important thing to remember is that improperly adjusted valves will cause valve burning if the clearance is too small and will pound out if the clearance is too great.



Schematic diagram of fuel system.

A. Air Chamber
B. Inlet Manifold
C. Exhaust Manifold
D. Injection Nozzle
E. Overflow Valve
F. Pressure Gage
G. Filler Spout Cap
H. Vent Tube
J. Fuel Tank
K. Secondary Filter
L. Primary Filter
M. Supply Pump
N. Hand Priming Pump
P. Injection Pump

Cooling System

The cooling system should have regular periodic care. Improper maintenance of the cooling system can result in an overheated engine which, if allowed to operate at excessive temperatures for a lengthy period, will develop serious troubles.

The rubber hoses in the cooling system should be inspected periodically and the fittings checked to see that they are water tight. The cooling water pump should be properly lubricated so that excessive bearing wear will be eliminated.

Radiator shutters are provided to regulate heat in the cooling system. The shutters should be lubricated and the filters should be drained to prevent any corrosion or rusting due to moisture which collects there.

It is good practice to see that the cooling water jackets and passages are kept free of rust and scale. This can best be accomplished by including a rust inhibitor or corrosion preventive in the coolant when it is put into the system. Regular additions of more inhibitor will insure that the cooling system is functioning properly and does not become clogged or plugged with scale and other matter. Do not mix different brands of inhibitors.

Oil Leaks

The engine should be regularly checked for oil leaks from gaskets. If a leak is discovered, it may be due to a cap screw which has loosened. A slight turn of the cap screw may stop the leak but care should be taken not to overtighten these screws. Overtightening will not only damage the screws but also will cause distortion and aggrevate the leakage.

Electrical System

The electrical system can also be a source of trouble. The connections and particularly the ground wires should be checked to see that they are clean and tight. The water level in the battery should be above the plates and the generator and voltage regulator should also be checked periodically to insure proper operation and to see that the battery is kept at the proper charge.

Conclusion

In the foregoing, an attempt has been made to give some of the reasons why a preventive maintenance program is all important to good economical operation. Some recommendations have been given as to checking the various parts of the engine. Good maintenance will, inevitably, bring forth good performance records. The engine, of course, has to be well designed and built in the first place. The Mack engine, and most other engines, meet these requirements and good maintenance will enable them to show good performance records over long periods of time.

DIESEL BRIEFS

ABOE Mobile Exhibit

Further implementing its extensive program of cooperation with distributors and dealers, ABOE, Inc., New York, early this fall will launch on a nationwide tour a new deluxe mobile demonstration unit which, for artistry of design and completeness of facilities, is believed to be unique in the diesel engine field.

Created especially for visiting and exhibiting at agricultural and industrial exhibitions, the new self-contained demonstration unit converts from a pair of semi-trailers of conventional appearance into an exhibition trimmed with the latest in display signs, and equipped with the most modern facilities for service to visitors.

At present the vehicles are touring Great Britain. At the close of the summer season they will be transported to this country, where ABOE and its distributors and dealers are arranging a tour of some 8000 miles.

Flexible Tubing Plant

Flexible Tubing Corporation, forced by increasing demands and production, will move into its new 13,000 sq. ft. brick and steel plant in Guilford, Conn., on November 15, 1950. The company, with plant and office now located in Branford, Conn., manufactures the world-wide distributed *Spiratube*, a flexible and retractable ventilating and products-conveyor.

The new plant, already under construction, will be on a large tract of land in Whitfield Street, Guilford, on the South side of the New Haven Railroad right of way. The site was selected with an eye to expansion, and because of the facilities for a railroad siding.

DEMA Regional Meetings

Harvey Hill, Executive Director of the Diesel Engine Manufacturers Association, has announced several one-day regional meetings to be held under the direction of Robert L. Stanley, newly-appointed DEMA Educational Director. The meeting dates and locations are:

October 12—Sinclair Refining Laboratories, Harvey, Ill.

October 17—Erie Forge Company, Erie, Pa.

October 20—Esso Laboratories, Linden, N. J.

October 21—Massachusetts Institute of Technology, Cambridge, Mass.

November 11—University of Washington, Seattle, Wash.

November 13—Shell Oil Company Research Laboratories, Emeryville, Cal.

November 29—The Cooper-Bessemer Corp., Grove City, Pa.

November 30—The Baldwin Locomotive Works, Eddystone, Pa.

The series of meetings is designed to aid professors who teach courses in diesel engineering. It is believed that these meetings will prove to be a distinct aid to such persons.

I-H Depot

International Harvester has announced that construction work on a new building which will house a service parts depot and a machine transfer in Broadview, a suburb of Chicago, was begun last month. The building, which will cost approximately $5,000,000, has been approved by Mercer Lee, vice president in charge of supply and inventory.

Lee stated that the parts depot and the machine transfer both would operate out of the new building, but that the operations of each would be entirely separate from one another. He said that the combined facilities would be the company's largest product distribution center and would be one of the largest in the United States.

Nicad Appointment

The Nickel Cadmium Battery Corporation has appointed the Valley Bearing & Equipment Company of 1 North LaSalle St., Chicago 2, Illinois as sales representative for Nicad Storage Batteries for diesel railway locomotive starting, according to an announcement by A. B. Strange, treasurer and general sales manager, Nickel Cadminum Battery Corporation.

The Valley Bearing & Equipment Company has been serving the railway supply field since 1942. Jean R. Huff and Armand Peycke are the principals.

DIESEL BRIEFS

Penn Move

The Boston district office of the Penn Electric Switch Co. has been moved to 313 Washington St., Newton 58, Mass. Mr. A. W. Barr, Boston district manager, announces that the new telephone number is Decatur 2-9540.

Penn Electric Switch Co. manufactures a complete line of controls for heating, refrigeration, air conditioning, gas ranges, engines, pumps and air compressors.

Ideal Buys Pyramid

Ideal Industries, Inc., has purchased Pyramid Products Co., Chicago, manufacturers of Wire Stripping Equipment. The Pyramid firm produces several items, best known of which is the "E-Z" Wire Stripper—a small hand operated tool for quickly removing insulation from wire. This tool will be added to Ideal's line of wire stripping equipment.

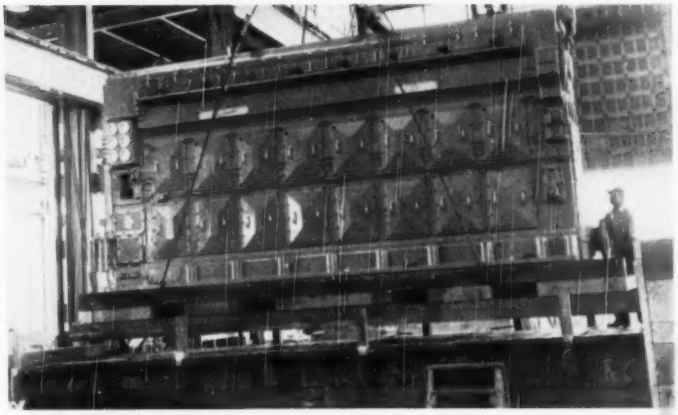
All manufacturing and sales activity will be moved from Chicago to Ideal's Sycamore, Illinois, plant.

Brush Buys Vivian

The Brush Electrical Engineering Co., Ltd., of Loughborough, England, has acquired a controlling interest in the Vivian Diesel Engine Works, Ltd. of Vancouver, British Columbia. The finance involved is of the order of 500,000 Canadian dollars.

The Vivian business was established some 40 years ago and has been built up by Mr. W. Vivian, who has seen it grow from its start to its present size. He is retaining a minority interest in the company and remaining on its Board.

The result of this new investment will be to establish the Brush and Associated British Oil Engines Companies more firmly in the North American market. Very active sales subsidiaries are already operating in Toronto and New York.



Superior Shipment

Power for New York's newest and largest sewage plant at Owl's Head Point, Brooklyn, will be supplied by six of these 1300-hp. Superior diesel engines. The first one was loaded for shipment recently from Springfield, Ohio, by the National Supply Company's Engine Division.

For economy of operation, the New York Department of Public Works has selected engines that will use either oil or sewage gas as fuel. Engines run also with both fuels together. Each engine will drive 900-kw. generators which will provide electric power for the new plant.

Contamination of beaches will be greatly reduced by next season when the plant will be treating approximately one-sixth of New York's estimated billion gallons of sewage daily.

National Name Change

Gould-National Batteries, Inc., became the new name of the National Battery Company recently when the stockholders of the latter firm approved the change proposed by the Board of Directors.

The same sales and field engineering organizations, which have been serving heavy industry, mining, the railroads and the telephone companies under the name of the Gould Storage Battery Corporation, will now operate under the new name of Gould-National Batteries, Inc. Sales and field engineering headquarters for this group will continue to be located in Trenton, New Jersey.

The policies, management and operation of Gould-National Batteries, Inc., will remain the same as those followed heretofore by Gould and by National.

I-H Dealer Record

Rish Equipment Company, International Harvester industrial power distributor, recently celebrated the delivery of their 100th International TD-24 crawler tractor to Coleman & Gay, one of West Virginia's greatest road-building contractors, at Rish's Charleston, W. Va. plant. While top executives of International Harvester looked on, L. S. Coleman of the contracting firm accepted delivery of the 140-hp. crawler.

With the delivery of the huge tractor, Rish set a nation-wide record for TD-24 deliveries by IH distributors. One of IH's largest distributors, Rish has six plants serving West Virginia, Virginia, and portions of Ohio and Kentucky. The rugged terrain of the territory served by this distributor has built a big demand for crawler tractors of the TD-24 class.

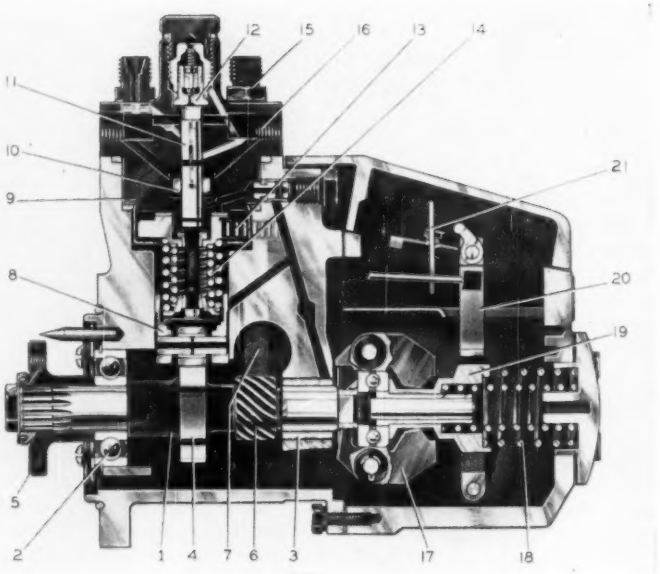
Bosch's PSB Fuel Injection Pump

THIS SINGLE-plunger distributor-type pump was developed by the American Bosch Corporation for small multi-cylinder engines on which the cost of injection equipment has long been a disproportionately great burden. It is characterized by simplicity and designed to be produced and maintained at comparatively low cost. Built with the precision of the other and earlier types, a single plunger and single delivery valve do the work of four or six such items in the older APE pump.

The PSB is intended primarily for 4-cyl. and 6-cyl. 4-cycle engines. It is of the cam-actuated, constant-stroke, sleeve-control type, the single plunger having a continuous rotary motion, in addition to its reciprocating motion, to serve as its own distributor. It has only a single delivery valve.

Mounted on and incorporated as a part of the unit are a fuel supply pump of the positive displacement gear type and a variable speed governor, which latter is usually of the mechanical type and driven directly off the end of the pump camshaft. Details of construction and operation will be given with reference to the accompanying illustration of the 4-cylinder unit. Three major elements comprise the unit; the housing with drive mechanism, the hydraulic head, and the governor.

The aluminum housing is cast with an integral, three-hole flange for mounting on the engine and contains the camshaft (1) which is supported at the drive end by a ball bearing (2) and at the other end by a sleeve bearing (3). The cam (4) has two lobes in the case of a 4-cylinder pump and three lobes for a 6-cylinder pump. The camshaft has a spline at the forward end to receive drive hub (5) and has a spiral gear (6) cut into it adjacent to the cams to mate with and drive the lower gear of the quill shaft (7). Through appropriate gearing, this shaft transmits the rotary motion of the camshaft to the plunger at one-half pump camshaft speed to perform the distributing function.



Cutaway view of the Bosch PSB 4 cylinder pump. Numbered parts are described and their function explained in the text.

The tappet assembly (8) is interposed between the cam and lower end of the plunger and consists of a shell mounting a hardened shaft on which turns a roller follower.

A timing window in the upper part of the housing is marked for plunger gear lineup during assembly and disassembly and a second mark indexes for port closing reference. There is also a timing pointer at the drive end of the pump to align with a mark on the drive hub.

The hydraulic head is a complete assembly, fastened to the housing by four studs. This design facilitates removal for service or replacement. The assembly consists of the head block (9), the control sleeve (10), the lapped plunger (11), the delivery valve assembly (12), the plunger drive gear (13) and the plunger return springs (14) which are held in place with spring seats and a spun-in retainer.

The plunger fits into a centrally ground and lapped bore in the head block and control sleeve so that these three pieces comprise an inseparable assembly. Four drilled discharge ducts (six in the 6-cyl. execution) extend symmetrically from the plunger bore to vertical discharge fittings (15). A downwardly inclined duct is drilled from the delivery valve bore to communicate with a horizontal duct entering the plunger bore at the plunger's distributing annulus nearly half way down its length. Drilled holes connect the fuel supply sump with the mid-section of the plunger bore that accommodates the control sleeve.

Fuel enters the pump from the supply system through the inlet connection (16) and fills the area above the plunger on its downward stroke. As the rotating plunger moves upward in its stroke, it closes the intake ports, forcing the fuel through the spring-loaded delivery valve and the communicating ducts to the annulus in the plunger and thence through the vertical distributing slot on the plunger and the discharge duct with which it is in register.

Control of the amount of fuel delivered is effected by the positioning of the control sleeve which terminates delivery at the desired point. A small flat is cut in the plunger below the annulus that functions for distribution. A vertical hole in the center of the plunger connects with a horizontally drilled hole at the flat. Thus pressure can only be developed when the flat is completely covered by the control sleeve, for as the upper or spill edge of the flat on the plunger breaks over the top edge of the control sleeve, pumping pressure is relieved down through the center hole of the plunger out into the sump surrounding the control sleeve and fuel delivery terminates despite the continued upward movement of the plunger. Excess fuel returns to the supply through the ducts that connect with the supply sump. The effective stroke is thus altered by the positioning of the control sleeve with respect to the spill edge of the flat.

The third element of the pump is the variable speed, mechanical, centrifugal type governor, which, although detachable as a unit, is considered as an integral part of the pump and operates directly from the end of the camshaft.

The assembly consists of an aluminum housing, attached to the rear of the pump housing with cap screws, containing a spider and weight assembly (17), control springs, outer for low-speed control, both inner and outer for high-speed control (18), sliding sleeve (19), fulcrum lever (20), step plate (21), and operating shaft assembly (not shown because of sectional view).

As speed is increased, the flyweights move away from the shaft; fingers on the flyweights act against a thrust bearing on the sliding sleeve to move the sleeve against the governor springs. The sleeve is connected to the fulcrum lever through pivot pins and the lever in turn is connected through linkage to the control sleeve in the hydraulic head. Thus movement of the flyweights is transmitted through the sliding sleeve to the fulcrum lever to the control sleeve which, as noted previously, determines quantity of fuel delivered.

Speed selection is obtained by positioning the lever of the governor's operating shaft which is usually actuated by a rod from the driver's seat or control panel. Extending through the governor housing and externally provided with a stop plate and limiting screws for adjustment of idling and full load speeds, the operating shaft is connected internally to a yoke by means of a torsion spring. The yoke is pinned to the fulcrum lever and serves as a fulcrum point. The effect is to vary the spring tension opposing the flyweight action and thus influence fuel delivery and engine speed.

In the upper portion of the governor housing is an adjustable stop plate in line with a smoke cam affixed to the upper end of the fulcrum lever. This mechanism serves to limit the maximum fuel delivery despite operating lever position, thus avoiding overloading the engine. The design also provides a means of adjustment of this mechanism to provide a torque build-up at declining engine speeds, an important feature for the tractor applications.

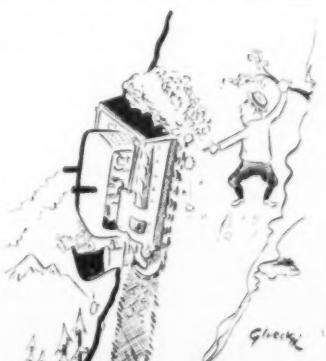
The pump and governor are pressure lubricated by the engine lubricating system. Drainage is through the front mounting flange to the engine gearcase. With some minor changes of the camshaft and internal gearing, the pump can be applied to two-stroke-cycle diesel engines and by similar changes it is applicable to those 4-cycle engines whose pump drive is at one-half engine crankshaft speed.

Stock Suit Settled

An out-of-court settlement of a long legal dispute between three Swedish firms and the United States Government over a large block of American Bosch Co. stock was effected recently. Announcement of the settlement was made by the Federal District Court which includes the Washington, D. C. area in its jurisdiction.

The legal dispute was over 535,000 shares of Bosch stock seized by the U. S. Government under the Alien Property Act in 1942. The Government, which has since sold the stock for more than $7,000,000, contended that a German company had an interest in the stock.

This allegation was denied by the plaintiffs in the actions, listed as the Stockholm Enskilda Bank and two corporations — the Aktiebolagret Varges and the Svenska Atiebologet Caritas. The settlement of the suit was for $2,600,000.



"You'll have to take a bigger bite than that if you expect to cut down this grade."

The stock was originally sold to the Swedish interests in 1940 by Robert Bosch Co. of Stuttgart, Germany. John C. Burling, Department of Justice lawyer, contended that the sale was made conditional on the Swedish interests reselling the stock to the Germans two years after the armistice.

The United States' profit out of the stocks' sale — some $5,160,000 — will go into the United States War Claims Commission fund to pay claims of Americans who suffered "unusual hardships" during World War II.

During the war, American Bosch Company had an enviable record of war production. The firm manufactures a complete line of diesel fuel injection equipment and also makes aviation and auto electric parts and other products.

High Additive Motor Oils

Versus

Fuel Quality and Engine Life

*by Hans M. Gadebusch**

THE ENGINE manufacturer's responsibility for lubrication should, by all rights, cease with delivery of the new equipment to his customers. Engine manufacturers are neither in a position to control the quality of lubricating oils nor have they much influence over important maintenance factors such as oil filtration, oil make-up and the unavoidable oil changes.

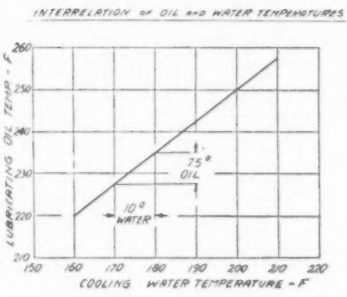
However, the new owner considers his power plant only too often as inanimate and, consequently, indestructible. Commercial interests coupled with a certain paternal feeling, dictate issuance, by the builder, of some kind of a lubrication formula insuring absence of early childhood troubles and long engine life. This formula which only a layman would insist calling an oil "specification", seldom refers any more to oil properties such as flash, fire and pour points, gravity, neutralization and precipitation numbers, carbon residue or color. Nor will an engine manufacturer dictate the type or strength of chemical additives in a motor oil. Nowadays it is well understood by oil men and engine builders alike that refinery inspection data or similar arbitrary specifications bear little significance to the performance of a motor oil and that engine tests alone can provide a satisfactory answer.

What then are the engine demands on a good crankcase lubricant and how can they be met?

Lubrication Quality

Lubricants for internal combustion engines have long since outgrown their primary function of separating moving parts by a resilient oil film. If it were lubrication alone which the engine user wanted to buy, the oil industry's problem would be fairly simple and could be satisfactorily answered with a wide variety of straight mineral oils. Lubricating quality of the oil is, therefore, taken for granted and engine manufacturers usually restrict themselves to prescription of the viscosity grade deemed best for good distribution of the oil throughout the engine and to recommendation of oil change periods.

Much more important than good lubrication are three other requirements related to the conditions under which the oil has to perform its basic duty in an engine.



Interrelation between sump oil and cooling water temperatures.

High Heat Resistance

One of the many tasks which engine designers expect a crankcase lubricant to perform is that of internal cooling. As long as this function involved only the removal of frictional heat from engine parts at moderate speeds and loads, the oil temperature problem was not too important. In 1926, oil sump temperatures of automotive engines were around the 130 deg. F which has formed the baseline for SAE crankcase lubricant classifications until recently.

Advent of high-speed engines, continued rise in specific output and increasing use of the oil as a readily available piston coolant, have created a temperature problem. At a normal cooling water temperature of 180 deg. F the sump oil of a 200 bhp. diesel engine reaches 205 deg. F when idling at maximum speed. Under the influence of the increased thermal and mechanical loads of full throttle operation, the maximum oil temperature rises as high as 235 deg. F in spite of most liberal use of oil-to-water heat rejection by means of an oil cooler. The resulting interrelation between sump oil and cooling water temperatures is illustrated.

In the water temperature range of from 160 to 210 deg. F a practically straight-line function is obtained indicating a 7.5 deg. F increase of the oil temperature for every 10 deg. F. rise of the cooling water. In mobile equipment, where the engine water represents the only available medium for oil cooling, continued full throttle operation of high-speed engines in warm climates will, therefore, quite frequently entail oil temperatures in excess of 250 deg. F. Accepting the chemists' word for it that the oxidation rate of mineral oils abides by the law for most other organic chemical reactions, *i. e.* doubles for every 18 deg. F increase in temperature, it may be seen that the deterioration of the lubricant under the influence of heat is one hundred and twenty-eight times

* *Staff Engineer, Detroit Diesel Engine Division, General Motors Corp.*
Abstract of a paper presented at the SAE National West Coast Meeting, Los Angeles, Cal., August 14-16, 1950.

higher today than it was twenty-five years ago. Oxygen absorption by the oil creates a multitude of other chemical compounds. Corrosive organic acids, varnish-depositing resinous materials and insoluble sludges are the better known of these oil oxidation products.

High oxidation resistance of the lubricating oil must be placed second on the list of motor oil requirements.

Carbon Formation

Even at normal rates of oil consumption, considerable quantities of lubricating oil are reaching a temperature zone at the upper part of the pistons where rapid oxidation, polymerization, evaporization, condensation and, ultimately, carbonization occur. The insoluble deposits thus formed may be the cause of many premature engine failures, particularly in the compression ring location.

The behavior of various types of lubricants under these temperature conditions was the object of tests conducted some years ago by the Detroit Diesel Engine Division in collaboration with the Mellon Institute. The group of test oils included paraffinic, Mid-continent and naphtenic stocks. The refining methods varied from acid treatment to solvent extraction and completely distilled as well as blended materials were used. The test engine was a commercial 6-cyl. 2-cycle diesel engine.

To exclude any possible falsification by fuel deposits, these tests were made under motoring conditions without any fuel injection. Piston temperatures approaching normal firing operation were artificially created by raising the compression ratio to 28:1.

The operating temperatures during this test work were as follows:

Cooling Water Out	130 deg. F
Air at Intake Ports	230 deg. F
Exhaust Gas	190 deg. F
Oil Sump	230 deg. F
Piston Rim	520 deg. F
Piston Center	450 deg. F

Engine observation after these tests permitted the following conclusions:

(a) The piston skirts, air intake ports and the crankcase oil remained practically clean. The amorphous carbon normally accumulating at these locations must be therefore considered as a combustion by-product.

(b) Piston land, compression ring and ring groove deposits were essentially identical with those found at part load operation under normal firing conditions. These deposits must be considered as primarily caused by the lubricating oil.

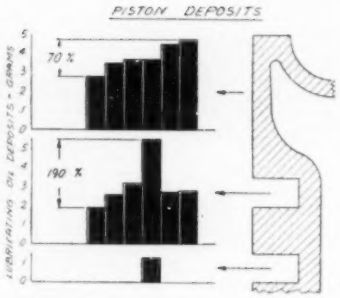


Chart of deposits and their distribution on a piston.

It must be understood that carbon formation of this type is not only the result of the basic carbon residue content of the lubricant but also reflects the subsequent increase in residue-forming material due to progressive oxidation during the test period. Consequently, the carbon residue value determined on a new oil cannot be considered as a quantitative measure of its deposit-forming characteristics in an engine.

For evaluation of the tested oils, the deposits from the top land and the two first ring grooves were removed and weighed. The results are illustrated. The overall variation in deposit formation between the best and the worst oils amounted to 70 per cent for the top land and to 190 per cent for the first ring groove. Differences of this magnitude certainly justify the positioning of low carbon formation at the third place of the list of motor oil requirements.

Non-Sludging Qualities

Ever since inception of internal combustion engines, cleanliness of all working parts and of the crankcase itself has been regarded as a foremost criterion of good lubricants. During circulation through the engine, the oil is continuously contaminated by foreign materials. Acids, varnish and sludge from oxidation, soot, polymerized fuel fractions and water from the combustion chambers, metal particles as the result of wear and dust carried into the engine with the intake air form the bulk of this contamination.

Unless these non-lubricating materials can be removed in some manner, they will reduce the lubricating quality of the oil, affect its viscosity, increase the wear rate and, finally, endanger proper oil supply by accumulation of insoluble sludges at vital points. Differences in the behavior of lubricants refined from naphthenic or paraffinic stocks with respect to sludge and deposit formation have already been observed and reported during the first decade of this century.

The earliest and simplest solution of this problem consisted of frequent oil changes—the more the better. When increased engine and oil life became factors of importance, attention was paid to elimination of at least the solid contaminating materials from the oil stream. Thus lubricating oil filters made their commercial appearance around 1928. Ever since that time a lively controversy has been going on whether solid contaminants should be removed by continuous filtration or kept in circulation and drained out at the oil changes.

The advent of selective refining processes in the early thirties temporarily tipped the scales in favor of a school of thought proclaiming that removal of all potential sludge-forming materials by refining and the resulting clean oil appearance also guaranteed clean engine interiors. Rapid oil oxidation, however, with the ensuing varnish and bearing corrosion troubles soon contradicted this theory. The result was a wide-spread technical interest in the nature of these unstable materials which were known to make sludge but apparently also imparted to an oil its oxidation resistance.

During this period, the science of chemical oil additives made rapid strides resulting in the development of oxidation inhibitors and detergents. Both these groups of additives fall

under the "non-sludging" requirement of good motor oils. Improvement of the oxidation resistance goes to the root of the trouble by minimizing sludge-forming materials from this source. Detergent additives, in turn, not only keep engine parts clean but also counteract sludge formation by keeping foreign materials in suspension in the oil stream from which the solids may then be filtered out by conventional means.

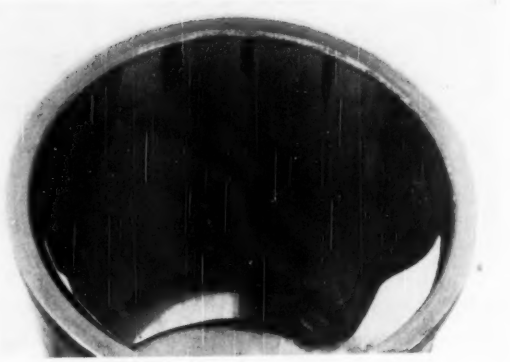


Illustration of abnormal wear of liner above the piston ring travel. Note fluting of cylinder surface.

Low Additive Lubricants

Recognition of lubricity, heat resistance, low carbon formation and non-sludging behavior as the four major requirements of satisfactory motor oils was greatly furthered by increasing commercial use of chemical additives. The spectacular success of the subsequently developed "Heavy-Duty" motor oils went past the fondest expectations of engine manufacturers and users. Piston varnish formation was practically eliminated, bearing corrosion difficulties were minimized, oil change periods could safely be doubled, engine cleanliness was at a new high level and engine life was materially improved.

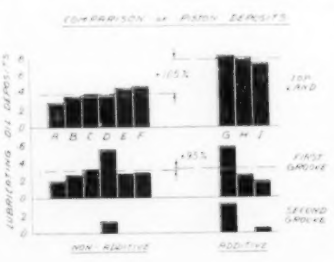
With increasing use of the new oils a few shortcomings made their commercial appearance already before the war. First, oil filtration became increasingly difficult. Engine operators used to clean dipstick readings had to be re-educated and, in some cases, detergency levels had to be reduced to prevent, for the longer oil change periods now permissible, excessive accumulation of carbon in the oil. Second, a number of field complaints regarding abnormal wear of the cylinder liners above the piston ring travel were registered.

A typically worn cylinder illustrates this point. Similar "fluting" of the cylinder surface may extend as far down as to the bottom dead center position of the top piston land. In most cases, however, it is limited to the upper third of the cylinder liner. Fortunately, compression ring life is rarely affected by this type of abnormal wear which causes excessive blowby and considerably reduces liner life with respect to reconditioning.

The study of deposit forming characteristics mentioned before was initiated by these complaints. After obtaining the results from six straight mineral oils the tests were extended to include three additive-type oils.

This comparison is illustrated. The first of the additive oils was made up from the base stock of Oil "F" plus 7 per cent of a commercial oxidation inhibitor. It may be noticed that this addition has increased the top land deposits by 72 per cent, those in the first ring groove by 105 per cent and has caused a residue in the second groove which before was deposit-free.

The other two additive oils were commercial products of the early "Heavy-Duty" period. Oil "H" contained only an oxidation inhibitor while Oil "I" was fortified by both oxidation inhibitor and detergent. The results obtained with these two oils were similar to the first, both showing materially higher deposit values for the piston top land than even the worst of the straight mineral oils. The average of the three additive lubricants is 105 per cent higher for the top land and 9.5 per cent higher for the first ring groove than the average of the six straight mineral oils. Another location at which oil additives sometimes put in an unwanted appearance, is the combustion chamber itself.



The piston bowl of a diesel engine with a heavy spider-shaped deposit as the result of 85,000 miles of city coach operation is shown. Residues of this type were first reported from the field as deposits of "white carbon" and baffled operators and service personnel for quite a while.

Analysis of this particular deposit produced the following values:

Combustible Material	6.8%
Inorganic	93.2%
Ash:	
Phosphorous	32.5%
Calcium	23.9%
Sulfates	11.6%
Iron	6.6%
Silica	2.4%

The chemically initiated will immediately recognize the tell-tale composition of the inorganic and, therefore, incombustible part of the detergent additive.

It must be emphasized at this time that the advantages of "Heavy-Duty" lubricants outweigh by far these shortcomings on the deposit side as long as the amount of oil burned by the engine remains within reasonable bounds.

High Additive Lubricants

Immediately following return to semi-normal conditions after the war, a wave of field complaints on wear and deposits inundated the service depart-

ments of most engine manufacturers. Equipment in operation was badly neglected, replacement parts had been scarce and engines were operated at oil consumption rates at which even the best straight mineral oils would have formed deposits faster than the engines could have possibly digested them. Gradual return to complete normalcy with re-establishment of sound maintenance practices and increased availability of new equipment promised a solution of these abnormal field troubles. But instead, they grew worse.

The same engines which had satisfactorily performed in pre-war times for 80,000 to 120,000 miles in trucks and coaches, now began to develop deposit troubles and premature wear after less than half these mileages. Stepped-up service schedules did not seem accountable for these complaints. Lubricating oil quality and oil consumption met the best pre-war standards. Engine building practices had remained essentially unchanged and were in many respects improved as the result of technological wartime developments. In this period of distress the engine builders' suspicion turned to the one remaining factor: The quality of the fuel.

Spokesmen for the Petroleum Industry had pointed out as early as in 1944 that large-scale utilization of catalyctic cracking might gradually affect the composition of diesel fuels and, in particular, lower the ignition quality. Nobody, however, could have predicted the severe fuel shortage which arrived in the wake of the war.

Rather than leaving industry, commerce and the millions of pleasure seekers without the lifeblood of their transportation or without heat for their homes, the refining industry met the challenge and produced up to the last barrel of their capacity. Fuel shortage, use of low-grade crude stocks and strained refinery schedules proved, in only too many cases, an unbeatable combination for engines, operators and manufacturers alike. Fuel oil samples obtained from critical areas at this time revealed Cetane numbers as low as 35, final boiling points as high as 760 deg. F, sulfur contents exceeding one per cent and,

Piston of diesel engine after 85,000 miles operation in a city coach. Note spider-shaped deposit in piston bowl.

in some cases, water dilution far in excess of what any refiner could leave in a distilled fuel even by accident.

It may now be fitting to quote the time-worn axiom that "Diesel Engines Will Burn Everything". Indeed they will, but at a price and since the engine operators went on record that they were definitely not going to shoulder the increased maintenance expenses, the engine builders were straining all available resources in an attempt to make good engines live with poor fuels. Many profitable innovations have been the result of this frantic search for relief.

Cylinder liners of increased hardness and corrosion resistance, better piston ring materials and widespread use of chromium as a wear-resistant coating are products of this period. But the clamor for help had also been heard in the quarters of the oil industry.

Since the basic engine ailments were properly diagnosed as accelerated deposit formation and wear and since detergent additives were known to be of a "cleansing and purging" nature, it appeared only too logical to combat the troubles by an additional dosage of detergency. Thus "Super-Duty" oils were conceived and the question now became: How much more additive?

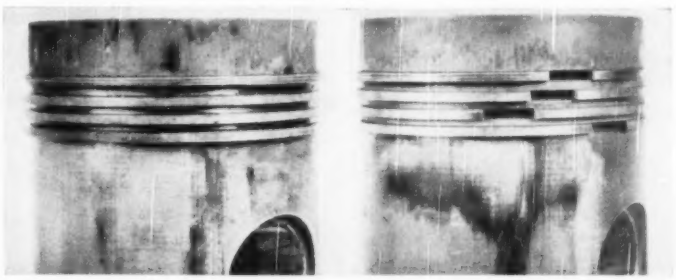
High Additive Content versus Fuel Quality

To be on the safe side and since nobody knew how bad the fuels could really become, the oil industry started by fortifying the lubricant with ten times as much additive as used in conventional "Heavy-Duty" oils. Startling results were reported from many sides. Deposits disappeared as if by magic, wear life was doubled, engine parts remained cleaner than ever before, and even that lowly accessory of an engine, the oil filter, profited by the "Super Oil". Since it was unable to retain much of the contamination any more, its change periods could be tremendously increased.

Any mention of piston land deposits, additive ash or lack of filterability of the new lubricant became to be considered as acts of treason and the increased price of lubrication was refuted by the argument that this trifle could be quickly recovered by the lower price of low-grade fuels.

Since the possibility to offset organic deficiencies of the fuel by strong medication of the lubricant represented a radically new theory, a cautious ap-

Upper portion of two comparable pistons after running with "super duty" and "heavy duty" lubricants.



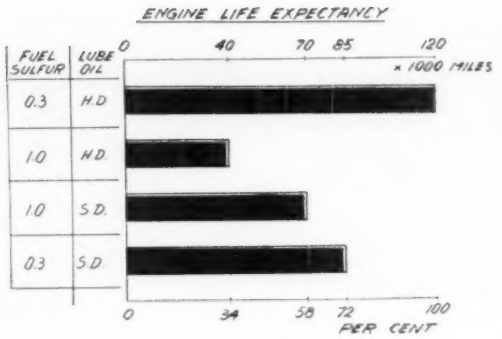
proach appeared in order. Consequently, a series of deposit formation tests was conducted with seven "Super-Duty" oils which were commercially available in 1948. These tests were conducted at 1200 rpm., full throttle, and extended over a period of 100 hours. The two low additive content lubricants used for comparative purposes were commercial 2-104b oils of good quality. To exclude exaggeration of the results by fuel influences, an ASTM #2-D diesel fuel oil of 0.3 per cent sulfur content was used.

It must be deduced first, that all "Super-Duty" oils are not alike. With almost 300 per cent difference in deposit formation between the best and the worst, it becomes evident that a high percentage of additive alone is not the only solution to better oil performance. A second conclusion must be that all high additive content oils leave more residue at those critical points in an engine where the lubricant is gradually decomposed to a solid.

While this increase in deposit formation amounted to only 33 per cent in the case of the best "Super-Duty" oil, the average of the seven oils tested was 223 per cent higher than that of the two "Heavy-Duty" lubricants. The corresponding appearance of the upper portion of two comparable pistons is illustrated.

In the two years since commercial introduction of "Super-Duty" oils a marked improvement has taken place in the fuel supply situation. Consequently, fuel quality has made a remarkable come-back thus eliminating in most areas of the United States the need for lubricants with extremely high additive content. As a direct result of this change, two types of motor oils with reduced additive strength have come onto the market: First, the so-called "Supplement 1" or "Extra Heavy-Duty" lubricants and, recently, oils conforming to the revised "Mil 2104" specifications intended to replace the original U. S. Army 2-104b standards.

While the former carry only about half as much additive as used in "Super-Duty" oils, they are still claimed to compensate fuels with a sulfur content up to one per cent and



Average values of engine life figures obtained from field testing.

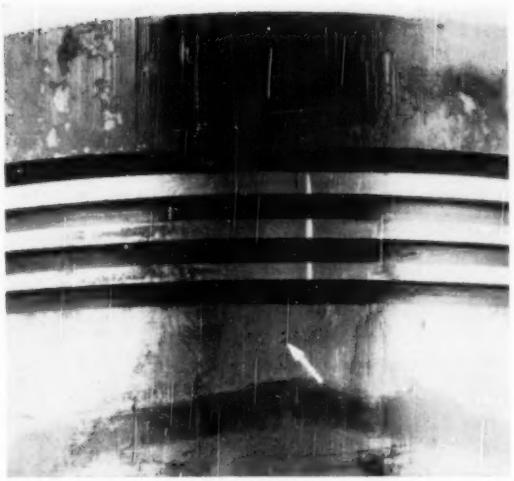
belong, therefore, rightfully into the class of high additive content oils. "Mil 2104" lubricants, in turn contain approximately 50 per cent more additive than used in the original "Heavy-Duty" oils. It is to be expected that this milder form of improved medication will be entirely sufficient to give satisfactory engine operation with the large majority of present day commercial diesel fuels without incurring the obnoxious carbon residue and additive ash difficulties associated with motor oils of high additive concentration.

High Additive Content versus Engine Life

As for engine life, there can be no doubt that the powerful cleansing properties of "Super-Duty" oils exert a beneficial influence upon the operation of diesel engines when low-grade fuels are used. It still remains an open question how much of this action is directly attributable to their deposit-removing qualities and correspondingly improved cylinder lubrication and what part the neutralizing action upon corrosive combustion acids plays which is claimed by some investigators.

Extensive laboratory as well as field tests of commercial "Super-Duty" lubricants have produced the usual variety of results. Numerical evaluation of engine life figures, particularly those obtained from field testing, is always a difficult problem and the average values given should, therefore be only considered as relative. The sulfur content of the fuel is used as a simple expression of fuel quality although it is by no means certain that this property alone is re-

Enlarged view of four compression rings showing deposits.



View of piston showing deposits and scoring. The rings shown on the opposite page were taken from this piston.

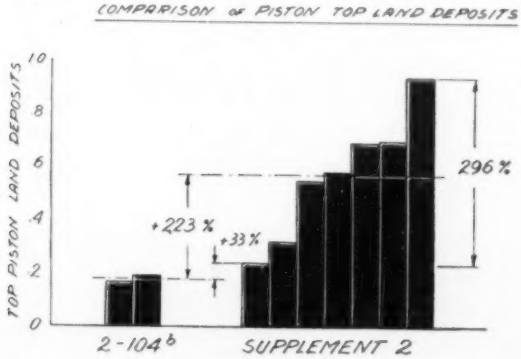
sponsible for the full magnitude of the differences experienced.

It may be seen that as much as 66 per cent reduction in engine life may result from use of low-grade, high-sulfur fuels with commercial "Heavy-Duty" oils of good quality. With the same fuel, use of high additive content lubricants of the "Super-Duty" type will be instrumental in recovering 24 per cent of the original loss thus resulting in an apparent 75 per cent overall gain. When compared to fuels of commercially acceptable quality, however, a lowering of the normal life expectancy of an engine up to as much as 30 per cent takes place with "Super-Duty" oils. The foremost troubles experienced were sporadic exhaust valve difficulties due to formation of additive ash deposits on the seating surfaces, premature abnormal cylinder liner wear caused by piston top land residues and extremely dirty oil due to filter inefficiency.

High Additive Content versus Oil Life

The tremendous cleansing power of high additive content lubricants is dearly paid for by their almost complete lack of filterability. In diesel engines considerable quantities of unburned carbon may reach the crankcase in form of soot. Without filtration, contamination values of five to ten per cent in 100 hours of operation are not unusual, particularly towards the end of the operational life and with fuels of poor burning quality.

To insure satisfactory oil supply to splash-lubricated parts, the thickening of the oil due to combustion soot must be counteracted by removal of this contaminant to a level not exceeding approximately one per cent.



Comparison of piston top land deposits after a 100 hour test.

If this reduction of the solid contamination cannot be achieved by filtration any more, the frequency of oil changes will have to be correspondingly increased and the function of oil filters may well be relegated to a superficial straining process. It is doubtful if the ensuing increased overall oil consumption together with the higher cost of "Super-Duty" lubricants will be readily accepted by many engine users.

Conclusions

During the past fifteen years, the petroleum industry has made tremendous strides towards the supply of motor oils combining improved lubricity with higher heat resistance and lower sludging tendency. Progress in this direction has enabled engine manufacturers to provide to their customers lighter, smaller and yet more powerful engines. The helpful part which oil additives have played in this development of higher rotative speeds and increased specific output, is well appreciated by all engine men.

Sufficient signs, however, are indicating that the fourth important property of a good crankcase lubricant, *i.e.* its residue-formation, has noticeably suffered by addition of oxidation inhibitors and detergents. While this shortcoming appears to be commercially tolerable with low additive content oils of the "Heavy-Duty" and "Mil 2104" types, it must be expected to establish a premature engine life limitation for lubricants of the "Super-Duty" type.

Further improvement of the relationship between engines, fuels and lubricating oils should be attempted from the engine manufacturers' side by reducing the thermal load which the crankcase oil has to absorb. On the petroleum industry's side, maintenance of sound standards for diesel fuel quality and increased attention to the residue-forming characteristics of motor oils appear as a technically more correct solution of the problem than addition of large amounts of chemicals to the lubricant in an attempt to offset the intrinsic deficiencies of poor fuel oils. Even the best lubricant cannot be expected to be a substitute for good fuel..

Diesel Engine Noise Control

*by A. S. Shipley**

NOISE CONTROL rings a different bell in the minds of people concerned with different phases of diesel engine operation. The manufacturer wants a noise level that is acceptable to the customer; the customer wants a level that will be tolerated by the general public. The operator wants a level that he can live with and understand. By the grunt of the diesel the operator can detect quick changes in load, and whether or not it needs his attention. By dozens of little noises that would pass unnoticed by a layman, the operator can detect improper injection timing, worn bearings and many other things.

Noise control in a diesel plant varies from acoustic treatment of the plant itself to jamming a piece of waste behind a rattling pipe, and noise frequently varies from sub audible air and ground borne pulsations to the ping of an overloaded cylinder. The noise from exhausts and intakes present pretty much the same problem, only intensified a little more in the one case because of temperature and pressure increases.

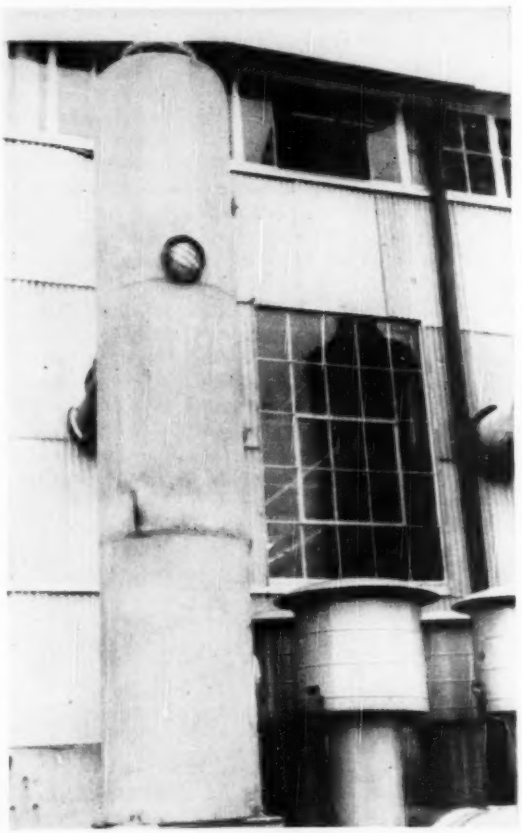
The fundamental cause of the noise is a surge of gas as the intake or exhaust port opens. The noise may be amplified by the piping system, but the principal problem is one of repeated surges. It is not necessarily a tone dictated by engine firing frequency, but a noise repeated at engine frequency—like a kid running along a picket fence with a stick.

In the event of an exhaust or intake affecting performance, the prime cause is the make-up of the exhaust or intake system—a case of the tail wagging the dog. Any piping arrangement will have a natural frequency at which it can be accoustically driven, much like a pendulum. Driven at this frequency, or at some multiple, it will 'go' with a resulting effect on engine performance which may be either good, bad or indifferent. Due to the complexities in attempting to tune a system to take advantage of the surges, the usual solution is to try to design a system that will not affect performance.

Exhaust and intake noise may be reduced by any one or a combination of the following general principles: 1. Acoustic treatment by means of sound absorbant material. 2. Acoustic treatment by means of tuned volumes designed to subdue certain pertinent frequencies. 3. Surge elimination by means of direct attack on the driving pulse that causes the noise (Snubbing).

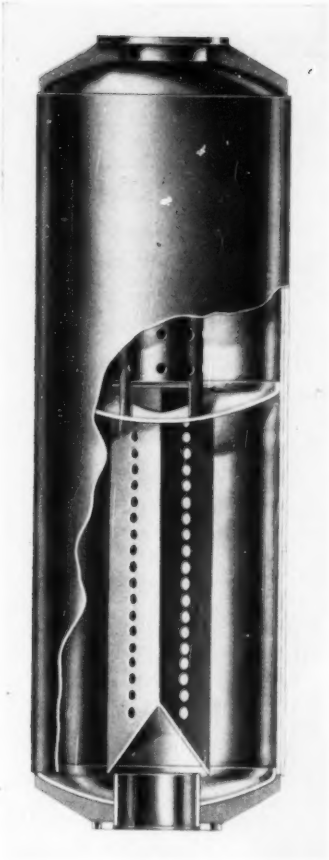
It is likely that if a research organization were given any one of these principals, and told to conduct intensive research on the problem, they would end up with a device incorporating phases of all three systems.

Design will depend on the character of the noise. For diesel engines, the snubbing principle is usually enough and the degree of silencing



(above) Close-up of a section of shell showing damaged section. Note separation of double shell. (right) Bulge in shell (bottom, second section) caused by repeated explosions. The bulge occurred where impact force of explosions was concentrated.

*Chief Development Engineer, Burgess Manning Co. Abstract of a paper presented at the Diesel Power Plant Conference at Iowa State College, July 24-26.



Cutaway section of Burgess Manning exhaust snubber.

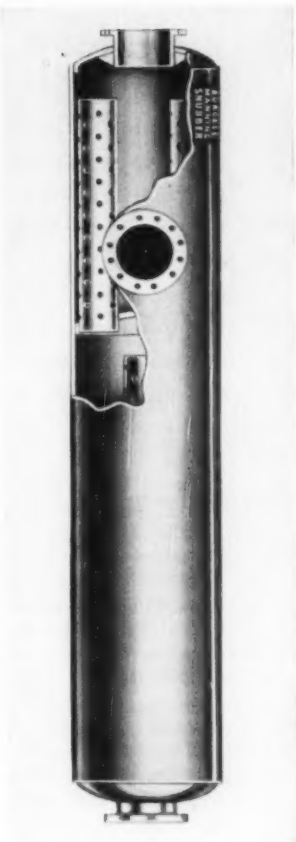
can be controlled by the number of properly sized snubber sections.

Mechanical design of the snubber is a matter worthy of considerable thought, particularly on the exhaust, since the snubber is subjected to amazingly severe shock waves. These waves are capable of causing a single wrapped shell, regardless of its thickness, to ring like a bell. This shell noise is one of the minor irritations of silencer design, and can almost always be taken care of by laminating the shell either by a continuous double wrap or by two separate shells tied closely together. This results in a 'dead' shell that will not ring freely.

Painting offers another problem that varies with service. Paints that will stand up under double attack of weather and temperature are scarce and expensive. Complete surface preparation, including removal of all rust and mill scale, is required before any paint will be serviceable. Even with perfect preparation and the best paint, when the snubber is subjected to either deliberate or accidental internal fires, temperatures may approach or pass the breakdown point for the metal.

Another problem which is becoming of greater importance is that concerned with explosions in exhaust systems, particularly with gas fueled engines. We made a field study of this several years ago to determine where design strength to withstand repeated explosions should be concentrated. We were surprised. Here again the laminated shell is considerably better than a single shell, even though the single wrap may be of heavier gage metal. Continuous welds are a must in design, not only along seams, but where inner heads are attached to the shell. But these things are basic and logical. Our surprise came in discovering how the explosions tended to deform the shell. Instead of puffing out like a balloon as anyone with normal intelligence might expect, we found that after repeated explosions the thing suffered rather local swellings at the end of the first section furthest from the inlet. Our earlier studies of the problem taught us how to design and weld them so that they would not lose their heads at the slightest provocation.

Exhaust system explosions in gas engines usually occur on starting. Gas is pumped into the system and ignition occurs at the engine end. The flame and accompanying pressure surge travels at tremendous velocity, and on entering the snubber chamber, inertia causes it to travel to the nearest exit before expansion takes place, with resulting concentrated local damage. Explosions are sudden and violent, and mathematicians have knocked themselves out trying to predict the results. It may be pointed out that explosion ports are added where such damage is considered likely, and these ports, made with light weight metal so as to break and relieve the pressure are often not damaged.



Another model of the Snubber. Construction is shown by cutaway section.

As to the primary purpose of the snubber, however, silencing can be bought in the degree desired for the particular job, and the better the silencer, the more the cost. An engine located in a factory area will require less silencing than one in a residential area. There is no need to drop engine exhaust noise below the level of surrounding noise, whether it be surrounding machinery or the clatter of the engine itself. Noise is not additive; a fight between four dogs cannot be heard twice as far as one between two dogs. In order to make an appreciable drop in the level of any sound, the energy of the sound must be reduced at least 90 per cent, and a 90 per cent reduction in sound energy is generally required for good silencing.

Battery Storage and Maintenance

International Harvester does a truly excellent job of disseminating service information within their organization from Regional Managers right on down to the Distributors. Service Bulletins are the medium of distribution and not only do these keep all informed of engineering and detail changes, but they frequently include engineering data and suggestions concerning service and operation. A recent bulletin deals with the storage and care of batteries. We asked and received permission to pass this information along to our readers. The text has been altered only to the extent of giving the article a slightly broader application to make it of greater interest to all our readers.

STORAGE BATTERIES are electro-chemical units and are subject to certain natural laws that place them in the class of perishable merchandise. If a new battery is given the required care, it will give dependable service. Without the necessary care, the battery will deteriorate rapidly. The cost of proper care is nominal, whereas neglect is expensive.

New fully charged batteries placed in storage are subject to self-discharge; therefore, they must be recharged regularly while in stock to keep them "healthy". Unless this is done, substantial damage may occur, resulting in shorter service life, poor starting performance, and dissatisfied users. If allowed to remain in a discharged condition, the battery plates become "sulphated", and assume a hard, non-porous crystalline coating which lowers the battery capacity and life.

Batteries must be fully recharged whenever the specific gravity reaches 1.240 corrected for temperature, or every 30 days. The average drop in specific gravity at normal temperatures (70 deg.-80 deg. F) is approximately one point a day over a 30-day period. Before recharging batteries, be certain that the electrolyte level is proper. If not, add sufficient distilled or approved water before recharging. Recharge batteries at the rate of one ampere per positive plate per cell. For example, a 15-plate battery has 8 negative and 7 positive plates per cell. Thus, the charging rate should be 7 amperes.

The following outline, when followed, will insure the availability of good, serviceable, fully charged batteries.

(1) Inspect newly shipped batteries, or batteries removed from new equipment, for damage to containers and covers and for accidental loss of electrolyte during shipment. Damaged batteries should be returned to vendor promptly for repair. Test all batteries received with an accurate hydrometer, and bring to full charge before placing in stock.

Proper electrolyte level is at "star level" (Auto-Lite batteries); if it is not at that level, add distilled water or approved water before recharging the battery. A fully charged battery has a specific gravity of 1.275 to 1.300 at 80 deg. F.

(2) Paint a number for identification on the end of the battery, and place the battery on a storage rack so the marked end is exposed to view. Arrange batteries of the same type on the same shelf and in the order as received so that the oldest battery can always be removed and sold first.

(3) Fill out a battery record card on which can be recorded the date received and the specific gravity readings of each cell. Identify each card with the same number previously painted on the corresponding battery. File the card in a container attached to the battery rack, the card remaining there until the corresponding battery is delivered to a customer.

(4) Batteries on the rack should be checked at intervals of not longer than 30 days and should be charged whenever the specific gravity falls to 1.240 (corrected to 80 deg. F). All gravity readings should be recorded on the corresponding battery record card.

(5) In batteries which are not equipped with "star level" indicators, the proper electrolyte level is about $\frac{1}{4}$ inch to $\frac{1}{2}$ inch above the tops of the separators. If it is necessary to add to the battery solution, use only *pure distilled water.*

(6) When a battery is placed in service, select the *oldest* battery of the correct size and type. Remove the corresponding battery record card from the container, fill in date of delivery, and file the card. The card is a history record of that battery up to its delivery in good condition to the user.

(7) Upon installation of a battery, be sure that all connections are complete and properly made before connecting the battery ground cable. Refer to the Operator's Manual.

Facilities for Storage of New Battery Stock

(1) *Location for Storage.* Store batteries in a room where they can be conveniently connected to a charging line for charging at 30 day intervals as long as they remain in storage.

Form suggested by International Harvester for the use of its dealers for storage battery records. This form can also be applied by users of batteries to give them a complete record of battery servicing and thus obtain increased service from their batteries.

STORAGE BATTERY RECORD CARD

Delivery Date _____ Tractor Model _____ Serial No. _____ Purchaser _____

Use this Card and Eliminate Battery Failures

Remove battery from tractor immediately upon being received.
Fill out lower line of this card, beginning "Date Received."
Test specific gravity; if below 1.240, place battery on charge. Record this test and every test made in space provided below until battery is delivered.
Place fully charged batteries in attachment room on rack constructed to provide that the oldest battery of each size be removed first.
Paint ready identification (number or date) on exposed end of battery.
Write the same identification at top of this card.
File this card in container attached to battery rack. (Card for each battery is filed in this container until battery is delivered.)
Test all batteries on storage rack every 30 days and put on charge if specific gravity tests 1.240 or below.
If necessary to add to battery solution, add only pure distilled water.
When installing battery in tractor to be delivered, use oldest battery of correct size.
Batteries should show a specific gravity test of not less than 1.275 when delivered to customer.
When battery is installed for delivery, its record card is filled out on top line beginning "Delivery Date" and is filed in customer file, with delivery report.

Date Received _____ Battery Type _____ Code Mark _____ Serial No. _____ Tractor Model _____

TEST RECORD

Date and by whom tested										
Specific Gravity, No. 1 Cell										
Specific Gravity, No. 2 Cell										
Specific Gravity, No. 3 Cell										

Fully Charged Specific Gravity at Different Temperatures

100° F	200° F	300° F	400° F	500° F	600° F	700° F	800° F	900° F	1000° F	1100° F
1.308	1.304	1.300	1.296	1.292	1.288	1.284	1.280	1.276	1.272	1.268

The above form is suggested for your battery record card. With this form, the line beginning "Date Received" is filled out when battery is received. The line beginning "Delivery Date" is filled out when battery is delivered. All specific gravity tests are recorded in space provided under test record.

Do not store near boiler or steam pipes as increased rate of deterioration occurs with higher temperatures. Preferred storage room temperature is between 32 deg. F and 70 deg. F.

(2) *Battery Storage Racks.* Batteries should never be piled on top of one another. Simple racks should be provided so that each battery is accessible for test and for rotation of stock. Damage to terminal posts and cell covers results from the weight of batteries stacked one upon another.

(3) *Battery Record Cards.* A suggested form is illustrated. These may be mimeographed or printed locally on light card stock.

(4) *Hydrometer for Testing Specific Gravity of Battery Solution.* The better types of hydrometers have a thermometer which gives a factor to correct readings to 80 deg. F. No hydrometer reading is strictly correct until a temperature correction has been applied.

The ideal charge at the reference temperature of 80 deg. F is indicated by a specific gravity reading of 1.280. After use or long periods of storage, a reading of 1.275 may be considered as a full charge. The temperature of the solution must be known and a corrective factor applied for accurate reading. At temperatures below 80 deg. F, 4 points or 0.004 must be subtracted from the specific gravity reading for each 10 deg. differential. Above the reference temperature the same increment must be added. Below are two examples of this procedure.

Battery Solution Temp. 100 *Deg. F.*
Hydrometer reading 1.255
Add 8 *points* ..... .008

Corrected sp. gr. is 1.263

Battery Solution Temp. 20 *Deg. F.*
Hydrometer reading 1.270
Subtract 24 *points* ..... .024

Corrected sp. gr. is 1.246

Charging

Assuming that a 12-battery size, bulb type charger with a 6-amp. output is used, the following number of batteries may be charged at one time at the rates given:

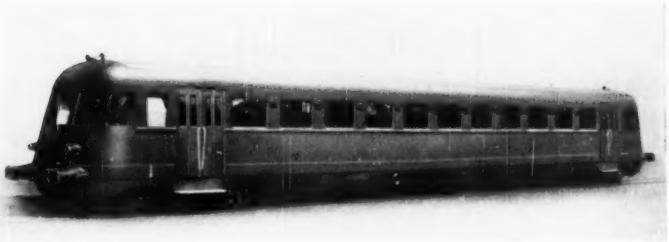
12 batteries at the full rate of 6 amp.
24 batteries at the rate of 3 amp.
36 batteries at the rate of 2 amp.
48 batteries at the rate of 1½ amp.

As a greater number of batteries are added to the charger, a greater amount of time is required to bring the batteries up to full charge. At intervals of 4 or 5 hours during the charging period, the temperatures of the battery solutions should be taken with a thermometer. Should the temperature exceed 110 deg. F., the charging should be discontinued until the solution in the cells has cooled. The maximum charging rate should be determined by the smallest size battery in the charging circuit. Do not remove a battery from the charging line at this point but continue the charge until there is no change in gravity for a three-hour period.

When 12 batteries are to be connected to the charger they are all connected in series. The positive lead of the charger is connected to the positive terminal of the first battery and the negative post strapped to the positive post of the second battery, etc., and, finally the negative post of the twelfth battery is attached to the negative charger lead. Additional series of 12 batteries are placed in parallel with the first group. The batteries are strapped as before with the positive terminal of the first connected to the positive charger lead. The negative post of the last battery is connected to the negative charger lead. Up to four series or groups may be connected in this manner.

New Italian Railcar

by R. Sansone



IN LINE WITH the trend to increased use of railcars in the United States and other parts of the world, an Italian firm known simply as "OM" has recently introduced a diesel powered railcar which can be used singly or in multiple units. This new railcar is powered with a 560 hp., 12 cylinder, horizontally opposed four cycle diesel engine made by OM and known as the Saurer S.B.D. engine.

The ALn 990 railcar embodies some of the features of the railcars used in this country and there are others which appear to be new. The car is powered by a diesel engine and has a fluid coupling mounted under the frame which gives greater revenue space inside the car. Other features are the use of a differential with the transmission in the engine compartment, the adoption of strong arms on the bearings of the trucks to improve transverse stability and the use of electro-pneumatic drives and controls.

Engine

The engine, as has been said, is a four cycle, direct injection, 12-cylinder, horizontally opposed engine with a bore and stroke of 6.24 x 7.8 inches. The piston displacement is approximately 535 inches and the engine has a continuous rating of 430 hp. at 1400 rpm. The maximum rating is 560 hp.

The water cooled engine drives through a combination fluid coupling and clutch arrangement. This apparatus is known as the OM Ljungstrom hydraulic control and has three stages. It contains a double friction clutch which permits direct drive through a flexible connection when the fluid coupling has been bypassed.

Other Equipment

In addition to driving the railcar, the engine also drives a dynamo to supply car lighting. The car also carries eight, six-volt, 230 ampere hour batteries. Fuel is carried in four compartmented tanks with a total capacity of 264 gallons. This enables the car to travel more than 600 miles at a commercial speed on grades under five per cent.

Electropneumatic driving controls are arranged to permit coupling two or three railcars together or one railcar and two trailers can be connected for operation. Each railcar has two sets of controls, one at either end, to permit maximum utilization of the cars and eliminates the necessity of turning the cars around after a run.

The car interior is heated by a hot air system of ducts and vents on the ceiling and floor. Heat is obtained from the cooling system of the engine and the heating system acts much the same as a counter flow heat exchanger with the engine cooling water giving up its heat to the car interior, thus accomplishing the dual purpose of heating the car and cooling the water.

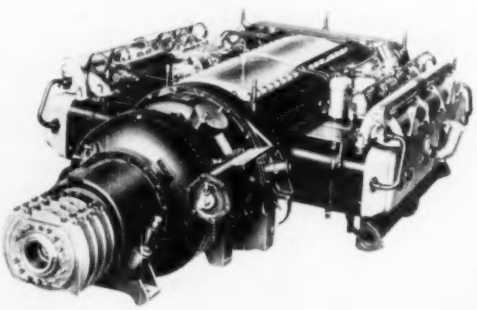
Braking is accomplished by an air brake system which is supplemented by a hand brake for additional control. There is also an emergency brake which can be used in the event of failure of the air brakes or in other emergencies.

Car Construction

The car is built of selected steel and is constructed with a frame, two side walls and a double-deck floor. Side sections are stampings which is believed to ensure good rigidity with low weight.

The trucks are made in two sections with double suspension and have semi-elliptic springs between oscillating beams and the truck frame. Cylindrical springs between the trucks and the balancers of the axles are also included. Wheels with changeable rims are 35.45 in. in diameter.

The interior of the car is very attractive. Seats are arranged in groups of four, each pair facing the other, and a wide aisle permits passengers to walk the length of the train with comparative ease. The entire car is insulated, both thermally and accoustically, with sprayed asbestos. Large doors are opened and closed pneumatically.



The four-cycle diesel made by OM named the Saurer S.B.D. engine.

Local Engines Make Good

WAUKESHA ENGINES

● With the "home town folks" there's no distance to lend enchantment. They know what you make, and how you make it. If they use what you make, like what it does for them and how it does it . . . and say so . . . you've got something!

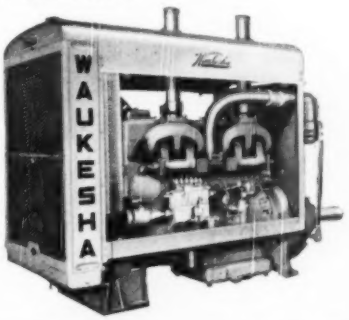
When Mr. E. J. Stephan and Mr. Grover Dobbertin tell you, "For many years Waukesha County has been purchasing road equipment powered with Waukesha Motors" and speak of Waukeshas' "fine performance" it *is* significant. They are the Highway Commissioner and the Chairman of the Highway Committee of Waukesha County.

They go on to say: "Most of our large maintenance trucks are equipped with your motors as well as a large power shovel and air compressor. These units have given us very satisfactory results.

"Just recently we purchased one of your LARGE DIESEL POWER UNITS for our new crushing plant and it is proving out far beyond our expectations. One short day we crushed over 600 yds. of gravel, which is about double the production of the unit owned and operated by Waukesha County previous to the installation of the Waukesha Motor Company Diesel . . . The service that you render when needed is superb."

The Diesel unit referred to is the Waukesha Super Duty Diesel. Mounted on its own trailer it is a general utility rig and may be used for any number of applications.

Consult Waukesha engineers on all your power problems. Send for Bulletin 1418.



SUPER DUTY DIESEL Model 6-WAKDU POWER UNIT six cyl., 6¼ in. bore x 6½ in. stroke, 1197 cu. in. displ., 190 hp. max. rating at 1300 rpm.

WAUKESHA MOTOR COMPANY, WAUKESHA, WIS., NEW YORK, TULSA, LOS ANGELES

New Products

Industrial Locos

A series of industrial diesel locomotives, featuring a hydraulic drive, have been announced by the Whitcomb Locomotive Company. The locomotives, known as Whitcomb Hydro-Motives, are designed to provide the smooth, uniform power of an electric drive, at far less cost, and to provide substantial economies in maintenance. They are available in sizes up to 25 tons.

The new hydraulic drive affords a marked saving in engine wear because road bed shocks are absorbed by the fluid Hydro-Motive coupling instead of being transmitted to the engine, as happens in a rigid mechanical drive. The drive, in itself, is of extremely simple design, to further assure low maintenance costs.

Benefits also accrue to the locomotive operator by way of reduced fatigue and reduced accident hazards. There is no shifting of gears, no jerking starts. Power is smooth-flowing, uniform at all speeds.

Vibrometer

An instrument designed to measure the amplitude of machine vibrations has recently been made available by the Vibroscope Co. Known as the Davey Vibrometer, Model P, the instrument should find wide application in the diesel field.

The instrument is applied by holding it against the machine to be checked. The width of oscillation of a light beam on a graduated ground glass scale indicates the amplitude of vibration. Two models are available which magnify the vibration 250 or 125 times respectively.

Power for the instrument is supplied by flashlight batteries housed inside the instrument. A detachable probe 8 in. long permits measurements to be taken on rotating shafts and also can be used to take readings in inaccessible or hot places. The probe is housed in a tube and turns in longitudinal ball bearings to minimize side friction.

Oil Tester

An instrument designed to measure the light transmission of a thin layer of crankcase oil to give an indication of its degree of contamination by carbon, metal and other particles has recently been introduced by the Photovolt Corporation. Called the Photovolt Photoelectric Crankcase Oil Tester, the new instrument will, according to the firm, indicate when the oil should be changed and how effective the oil filter is in keeping the oil low in contamination.

In operation, a few drops of crankcase oil are placed in a cuvette which consists of an optically flat glass disc that is cemented into a metal ring. This ring is placed in the instrument and light is passed through the sample. A meter on the top of the instrument gives a reading of light transmission and the operator can use this reading as a guide to the condition of his oil, according to the manufacturer.

Air Impactools

Ingersoll-Rand Company announces two new air operated *Impactools*, the Size 504 for nut running up to $^3/_8$ in. bolt size, and the Size 510 for nut running up to $^3/_4$ in. bolt size.

The Size 510 *Impactool* is a completely new size tool in the company's line of air and electric *Impactools*. Designed for jobs where it is convenient or necessary to have one hand free to hold the work or pick up the next nut to be run, the Size 510 is the most powerful *Impactool* built for one hand operation. It weighs $11^1/_4$ lbs. and measures $10^7/_8$ in. long.

The Size 504 *Impactool* is a completely redesigned tool. 20 per cent more powerful and 65 percent faster than the old model 504 tool. Due to the extremely effective muffling, it takes 100 new 504 models to equal the noise of one old model 504. The new Size 504 tool weights $5^3/_4$ pounds and is 8 9/16 in. long.

Solderless Connectors

A new line of Underwriters' approved connectors for solderless splicing and terminating of electrical wires has recently been introduced by the Buchanan Electrical Products Corp. In

addition, a tool designed especially for use in installing these connectors has also been made available by the firm.

Known as "*pres-SURE*" connectors, the new products are designed to eliminate the need for "costly, bulky solder equipment and danger of shorts and grounds from punctured tape on soldered joints or from loose fixture type connectors". The connectors and caps are applied with the new tool which brings pressure on four points on the periphery of the connector etc. and forms what amounts to four teeth which grip the wire firmly. It is claimed that there are several advantages to be gained by the use of this new equipment, including lower maintenance, maximum electrical conductivity, vibration-proof, high-strength connection, etc.

New Micrometer

For taking most measurements required in automotive repair work, the Central Tool Company now offers a new Range Micrometer—Model 400 RM. With three interchangeable extensions, the new tool measures any

part, from a pin to a large piston, within a 0 to 4 in. range. Each extension is individually adjustable to compensate for wear. A new and unique feature of Model 400 RM is the crowned face of the anvil (patent pending) which eliminates "gagging" when adjusting the tool to take the measurement. Each Model 400 RM is furnished complete with ratchet stop and locknut.

Anti-Freeze

Speco, Inc. announces an important improvement in its alcohol type anti-freeze, *Freez-Rem*. This consists of the addition of a new type of rust inhibitor chemical developed by Speco and known as *Speconite*. The latter is reputed to prevent rust and corrosion of metals in engine cooling systems. It will not damage rubber hose or hose connections.

Freez-Rem is formulated especially to meet the heavy duty demands of modern automotive, farm equipment and construction machinery cooling systems, according to the manufacturer. It is a blend of super refined alcohols and is reputed to possess a higher boiling point than is encountered in normal engine operations. Consequently, the manufacturer claims there will be little, if any, loss of content during the winter season. This high boiling point also gives extra protection against freezing. Tests indicate that *Freez-Rem* provides as much as 30 degrees more antifreeze protection than ordinary solutions. It will not leak out of any cooling system tight enough to hold water.

Motor Analyzer

A new motor analyzer which is said to register all engine troubles in written form has been placed on the market by Auto-Graph Corporation. Marketed under the name "Auto-Graph", the new instrument is self contained and operates independently of outside power. The complete machine consists of a cabinet base, an upper cabinet housing the working mechanism, and a top cabinet for master graphs printed on a metal wheel which rotates to expose each pattern behind a windowed opening. The recording tape is driven by a heavy-duty, spring-wound motor.

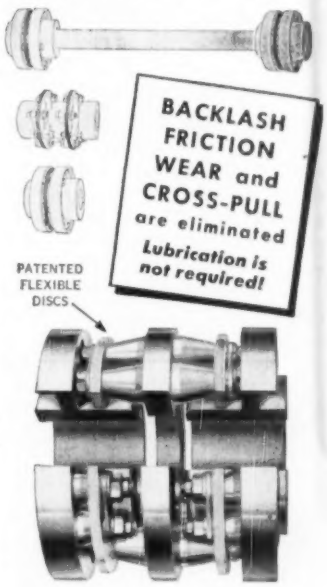
A spokesman for the firm, in commenting on the new product, said: "Variations in engine vacuum echo specific mechanical conditions within the power plant. Worn piston rings, weak or broken valve springs, pitted, warped or sticking valves, improper timing, leaky gaskets and other defects produce a distinctive vacuum response. The new analyzer incorporates a precision pen which is actuated by the impulses to the engine vacuum to translate each vacuum change into written autographs. By comparing these graph patterns with the master graphs, it is possible to interpret any engine fault."

THOMAS
Flexible ALL METAL
COUPLINGS
FOR POWER TRANSMISSION
REQUIRE NO MAINTENANCE

Patented Flexible Disc Rings of special steel transmit the power and provide for misalignment and end float.

Thomas Couplings have a wide range of speeds, horsepower and shaft sizes:
½ to 40,000 HP
1 to 30,000 RPM

Specialists on Couplings for more than 30 years



THE THOMAS PRINCIPLE GUARANTEES PERFECT BALANCE UNDER ALL CONDITIONS OF MISALIGNMENT.
NO MAINTENANCE PROBLEMS.
ALL PARTS ARE SOLIDLY BOLTED TOGETHER.

Write for the latest reprint of our Engineering Catalog.

THOMAS FLEXIBLE COUPLING CO.
WARREN, PENNSYLVANIA

Hose Cover Stripping Tool

Aeroquip Corporation has now available a Hose Cover Stripping Tool for removing the outer cover from Aeroquip Double and Single Wire Braid Hose as is necessary prior to attaching the fittings.

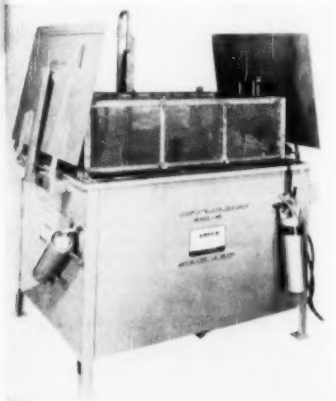
While the outer cover may be removed by hand, the stripping tool, No. F-1785, will greatly speed up this operation and allow users to take even greater advantage of the many features of Aeroquip hose lines.

The Stripping Tool may be used with equal efficiency by placing it in a standard shop vise, lathe chuck, drill press or in the revolving chuck of the Aeroquip Hose Line Assembly Machine. Compact and manufactured of quality materials, each part of the tool is individually replaceable. Each mandrel is designed to insure the user automatically removing only the amount of cover necessary for assembling the corresponding hose fitting.

Agitating Machine

D. C. Cooper Co. announces the development of a Pneumatic Agitating and Dipping Machine, especially designed for automatic cleaning of metal parts, dipping of spare parts in rust preventives, oils and grease, and other uses.

The machine consists of a sturdily constructed steel tank, with bottom drain and overflow near top. It is equipped with an air cylinder for



operating the rack. Special valves and switches control the various operations of the rack.

By a simple push button operation, the rack will lower to the bottom of the tank and automatically start agitating. By pushing a button, agitation can be stopped and the rack raised flush with the top of the tank for loading and unloading.

The agitation consists of a vertical stroke of approximately 5 inches, with a speed of 18 to 20 strokes per minute, as a normal working speed. Speed can be adjusted faster or slower as desired.

The machine is equipped with a rectangular, removable frame fitting within the inside area of the tank, designed to support a platform, basket or both. The basket and rack are removable and interchangeable, and of heavy duty construction.

Water Coolers

Three new *DriCooler* models have been added to the line of dry cooling equipment manufactured by The Marley Company, Inc. Two of the models are small "portable" units, while the

other model is designed to fill the need for a medium size unit. Although designed primarily for cooling engine jacket water, they can also be used for cooling natural gas, lube oils, chemical solutions, fluids of refining stages, ammonia or steam condensing, etc.

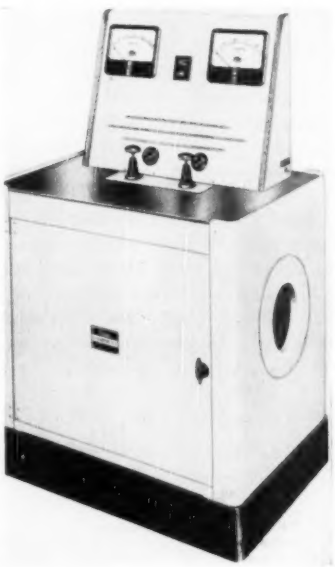
Models L and M, the portable units, are both forced draft, and have the same cooling capacity. Model L, however, has the fan and tube sections mounted vertically, while Model M has them mounted horizontally. There are seven different sizes of each model. Model JJ units are larger in capacity, and are also forced draft, with horizontally mounted sections. The four sizes of this model supplement the heavy-duty application *DriCoolers*, Models J and K.

Standard sections on these units are made of round copper tubes with pressure-bonded aluminum or copper fins, brazed into formed steel pipe headers. They are designed to operate up to 150 psi. at 300 F. Framework is made of heavy angle columns braced with angle members. Casing is heavy gauge steel, stiffened with structural angles. Units are completely fabricated and are piece-marked for easy assembly. A corrosion-retarding paint is shop applied. Marley cast aluminum alloy fans are used with a V-belt drive. Fan shafts move on grease-packed bearings in an enclosed bearing housing.

Engine Dynamometer

A line of compact and low cost engine dynamometers designed for engine run-in in service shops and end of production line testing has been placed on the market by the Clayton Manufacturing Company.

These models, included in the company's production of engine and chassis dynamometers, will operate with horsepower ratings from 50 to 2,000 at many different speeds. Each unit will handle an extremely wide range of speeds and powers, according to the manufacturer, thereby making



possible the testing and "running in" of a variety of engines on the same machine.

This flexibility makes dynamometer operation practical in many shops where it was formerly uneconomical. The machines can be adapted readily to the needs of diesel and gasoline engine manufacturers, engine rebuilders, automotive fleet shops, aircraft and marine engine shops and electric motor manufacturers.

Positive as well as flexible control of the torque load set for the engine to be "run in" or tested is guaranteed. The load can be varied instantly at will, or maintained indefinitely without the slightest change. Loads may be increased or decreased and then re-established without sacrificing accuracy in any degree. Standard equipment includes direct reading electric speed and horsepower meters.

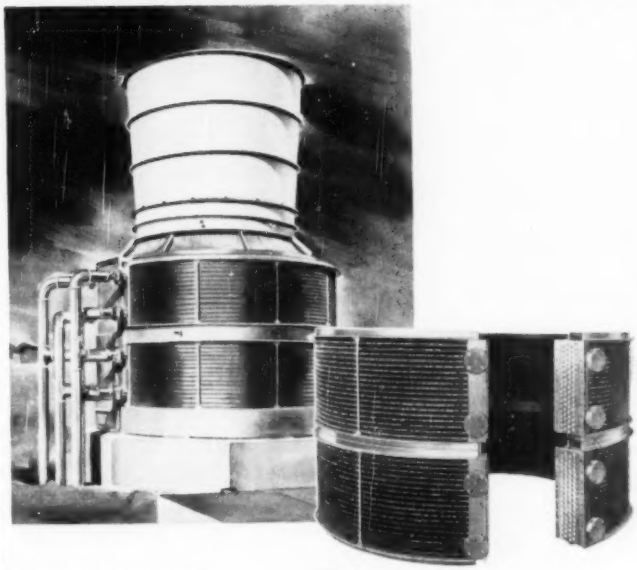
Air Intake Snubber

A new type air intake Snubber for industrial noise abatement and improvements in exhaust Snubbers, were announced recently by the Burgess-Manning Company.

The new type, known as SOA Series air intake Snubber is said to be a compact, economical unit for installations where noise rather than air surge is the major problem in internal combustion engines, compressors, and blowers. It is suitable for applications to all but the most critical intakes of rotary type blowers and compressors. The SOA Series, weighing from 110 to 3700 lbs., snubs or checks incoming pulsations of air, so that the oscillating air flow that causes pumping noise is smoothed into a more unidirectional flow, and noise is reduced.

The SOA Series, designed for most industrial and non-critical locations, is for use on blower scavenged or naturally aspirated internal combustion engines, positive displacement rotary blowers and for mounting on top of filter houses used with pump scavenged internal combustion engines. The new series replaces the SDA Series, which were designed to do the same job, but were larger and heavier, and therefore somewhat limited in application.

for Efficient HEAT EXCHANGE

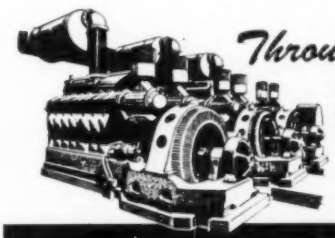


Pictured above is the new Type "E" QUINT-AIR *Air Cooled Heat Exchanger*, designed, engineered and manufactured by J. F. Pritchard & Co.'s Equipment Division. Curved Aerofin sections *(see illustration at right)* enable this unit to take maximum advantage of winds from any direction. Especially suited for engine and compressor jacket water cooling.

...Always
Specify *AEROFIN*

Regardless of the heat-exchange application — or the operating conditions which prevail . . . regardless of the type of atmosphere or liquid, Aerofin will supply the design and materials best suited to the job.

Aerofin's unequalled experience, research and manufacturing facilities in the heat-exchange field are your assurance of greatest efficiency and longest service life.



Throughout the Power Industry—
Aerofin units do the job Better, Faster, Cheaper

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Aerofin is sold only by manufacturers of nationally advertised fan system apparatus. List on request.

Pinion Heater

An induction pinion heater developed by National Electric Coil Co. for their own use has been refined and made available to industry. The rig is designed to remove pinions easily and quickly without damage or the use of high tonnage forces.

The new heater generates heat within the pinion, the principle being that the pinion will expand under the applied heat and will then be easily removed from the shaft. To remove a pinion, wedges are snugged up behind the pinion or pressure is applied by a simple pinion puller. The heater is placed around the pinion, ground clip attached to a bolt head on the motor, and the power cable carrying a ground wire is excited by a 440 volt, 60 cycle power source. Within a short time, according to the firm, sufficient internal heat will be generated within the pinion so that it can be removed with a fraction of the pressure required when removing cold with a hydraulic puller.

The coils are available from 4 to 9¾ ID in ¼ in. increments; from 10 to 16 in. OD in ⅛ in. increments. All have a 5¼ in. face.

Alco Increases Ratings

An increase of nearly 25 percent in continuous tractive effort on Alco-GE 1600-hp. road switching locomotives has resulted from major improvements in traction motor design, it was announced by American Locomotive and General Electric.

In announcing the new design, Alco-GE—originators of the all-purpose road switching locomotive nearly four years ago—stated that the new motor is the nearest approach yet to a self-protecting traction motor. It allows operation, in many cases, up to the point of locomotive wheel-slip without entering the range of short-time restrictions. This is accomplished with normal gear combinations which provide high maximum speed, as well as increased hauling ability.

Continuous operation up to 52,500 pounds tractive effort is available with the new road switcher traction motor, an increase of almost 25 percent over the former 42,500 lb. tractive effort for the same 65 mph. maximum speed gearing. Motor performance has been improved through the use of new insulating materials. The engineer's load meter now shows a maximum permissible continuous current of 1085 amperes, the former maximum being 900 amperes.

Additional engineering changes and modifications have been designed to provide added economies in road switcher operation and maintenance as well as greater versatility.

Hydraulic Drive

The Twin Disc Clutch Company announces the Model HUD Disconnecting Hydraulic Coupling (patent pending), a new type of hydraulic drive which "dumps" the hydraulic fluid when desired to serve as its own master clutch and provide a complete disconnect between the prime mover and the load. With the exception of provisions for the disconnecting feature, the new unit is similar to other

CORROSION PREVENTION

with typical Chromate Applications

LOCOMOTIVE DIESELS—Add 6 lbs. of Sodium Chromate to systems having a capacity of about 250 gal., and maintain concentration at about 2500 ppm.

MARINE DIESELS—Start with about 2000 ppm of Sodium Chromate in the engine-jacket system, and maintain this concentration. Submarines and some other naval vessels provide an additional factor of safety by employing 5,000 ppm.

STATIONARY DIESELS — Start large installations with closed engine-jacket systems by adding 1000 ppm of Sodium Chromate; later maintain about 400 ppm. For smaller installations, employ higher concentrations. For open systems, start with 500 to 1000 ppm of Sodium Chromate and lower the concentration over a period of 1 to 3 months to the lowest maintained concentration at which protection is satisfactory, usually about 200 to 500 ppm. For large open systems employing cooling towers, use Sodium Bichromate and adjust to pH 7-9.

Write for complete information about the applications in which you are interested.

SODIUM CHROMATE • SODIUM BICHROMATE
POTASSIUM CHROMATE • POTASSIUM BICHROMATE

SINCE 1845

MUTUAL CHEMICAL CO. OF AMERICA

270 Madison Avenue, New York 16, N. Y.

Twin Disc double-circuit hydraulic couplings in both design and operating characteristics.

To act as its own master clutch, the new coupling is capable of dumping the hydraulic fluid in from one to four seconds, depending upon the speed of the coupling. When a control valve is actuated to cut off the oil supply the hydraulic fluid is rapidly released into a reservoir through four differential pressure dump valves, which are located in the outer diameter of the coupling.

With the hydro-kinetic connection broken by the absence of the oil, the engine or motor can continue to run indefinitely without harm to the coupling or driven equipment. Special provision is made for adequate lubrication during these periods.

When the control valve is re-set to again engage the load, ingenious differential pressure valves on the coupling's outer diameter rapidly close. This permits the coupling to quickly refill for normal hydraulic coupling operation.

Railway Signal Lamp

A new light bulb for use in railway signal lamps is available from the Westinghouse Lamp Division. Designed to replace the oil-burning lamps now in use at an estimated 500,000 switches throughout the country, the new bulb will greatly reduce maintenance time and expense.

The new bulb became practical upon the development of a new type primary battery by the Primary Battery Division of Thomas A. Edison, Incorporated. Lamp life is expected to exceed the ten months that the battery can operate continuously, but for lowest maintenance cost, the lamp will be replaced at the time the battery is replaced.

The lamp is available in ratings of 0.15 amp at 2.7 volts, and 0.12 amp at 3.5 volts. The inside frosting of the bulb diffuses the light to approximately oil-lantern-flame size, making it possible to retain existing optical systems in converting. Because of the absence of the soot and dirt of an oil flame, the new lamp burns with practically equal brightness throughout

Patented Palm-Grip Design. Handles give a secure hand grip and better appearance.

32-tooth ratchet action—pawl always makes a double tooth contact for added strength.

Easily removed Welch plugs permit cleaning and servicing of friction grip device.

Four-way socket grip makes it easier and faster to interchange various units. Hot broached chip-curled openings give you smooth strong socket walls.

Snap-on metallurgists select only high grade alloy steel to produce Snap-on wrenches.

Controlled heat treating combines surface hardness with skin-to-core toughness in every part of every tool.

Snap-on Tools
THE CHOICE OF BETTER MECHANICS

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Check the features at the left, then ask the Snap-on man to show this set to you. Ask him to demonstrate — try the feel of the tools yourself. You'll agree that mechanics who use dependable tools like these will be a definite asset to your shop.

Over 4000 Snap-on tools are available through 41 direct factory branches located in key industrial areas.

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life, and is unaffected by wind, rain, or snow.

New Stand-By Power Plant

Because of increasing interest in Stand-By electric power, the Kato Engineering Company, Mankato, Minn., has placed a new model on the market. This electrical plant is powered with a two cylinder, air-cooled Wisconsin Engine. There is no radiator; consequently, no solution to evaporate, nor anti-freeze solution to worry about. The plant can be installed in freezing atmospheres if desired. The engine is equipped with a high-tension magneto permitting hand-cranking and there is no need for batteries of any kind unless electric cranking is desired which is also available. The Generator has a rated capacity of five kilowatts. It is conservatively rated, consequently, it will start single phase motors up to three horsepower. The plant is available with automatic transfer switch. Generator is designed to give inherent voltage regulation. Voltage regulation is held to eight per cent on non-inductive loads.

These Stand-By Power Plants are designed to run at 1800 rpm. They are designed for continuous operation; however, *Katolight* engineers have always recommended lower speed, 1200 rpm, where plants are to be the only and sole source of electrical supply, and if your requirement calls for many hours a day, day after day, year in and year out, *Katolight* generators are built in 1200, 900, and 720 rpm; in capacities ranging from 500 watts to 300 kilowatts at 60 cycle. They are also available in frequencies ranging from 25 cycles to 400 cycles.

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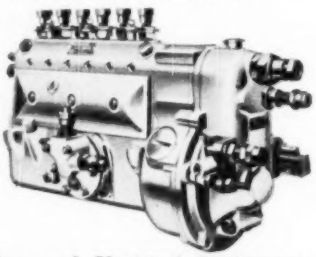

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New Literature

Goulds Publication

Complete information on the new Goulds self-priming centrifugal pump is now available in a bulletin recently issued by Goulds Pumps, Inc. The pumps are of a new design that eliminates valves and yet gives efficiency comparable to standard centrifugal pumps.

Included in the new booklet are photographs and specifications for the pumps as well as a general description, principles of operation, applications, features of construction, dimensions and performance tables.

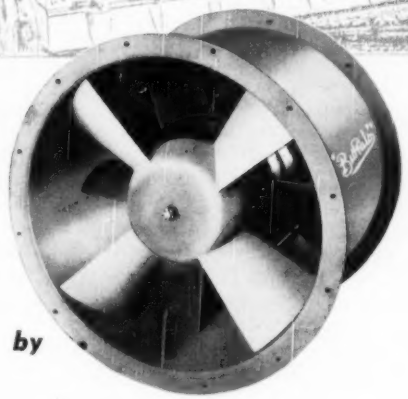
A-C Bulletin

The automatic Vari-Pitch drive, a simple, low-cost method of instant speed control covering most speed changing needs from 1½ to 40 hp, is described in a new 12-page bulletin released by Allis-Chalmers Manufacturing Company.

According to the bulletin, the automatic Vari-Pitch sheave has been used successfully on all types of textile machinery to vary the speed and rate of delivery of pumps, blowers and compressors; to provide variable speeds for variable frequency generators and many other types of testing machines; to synchronize speeds on packaging machinery and conveyors; to provide variable speed on machine tool spin-

MORE EFFICIENT

WHEN DEPENDABLY COOLED



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- Easily installed for mobile or stationary Diesels!

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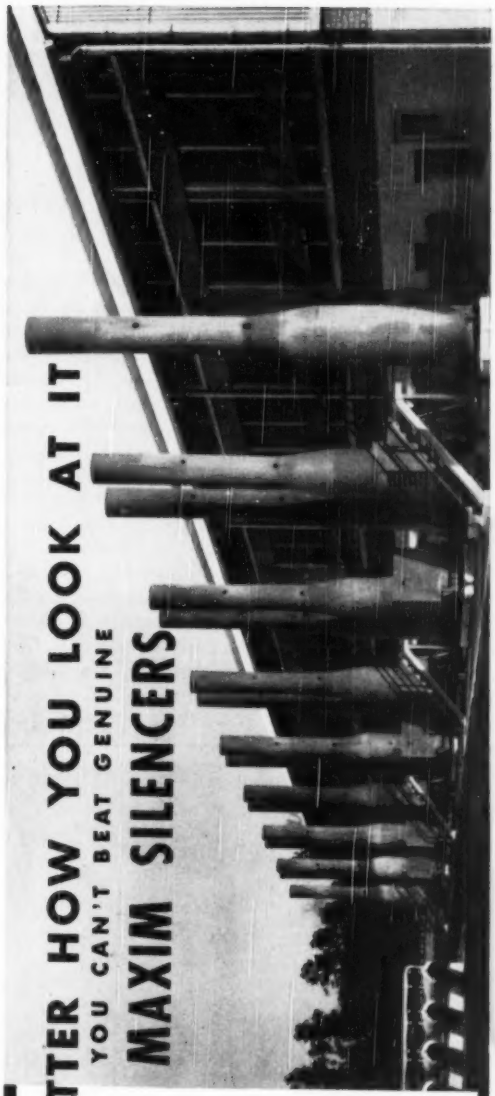

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dles; to drive mixers and agitators, and to vary the speed of many other types of equipment in many industries.

The bulletin carries instructions and tables to enable individuals to figure the components needed to assemble a drive for almost any speed range and horsepower within the range of this drive.

Water Test Booklet

The extremely rapid, simple and accurate new "one-minute tests" for determining water hardness are described in Bulletin 1RE50 just issued by Hall Laboratories, Inc.

Procedures, reagents and equipment for the new tests are pictured and described. The test procedure requires approximately one minute to complete, in contrast with the century-old "soap-shaking" method. Because of clear-cut color change at the endpoint of the tests the subjective or human-error element is eliminated. Accuracy to within 1 ppm. has been demonstrated.

The new tests may be employed to determine total water hardness; hardness due to calcium alone; or hardness due to magnesium alone (this last simply by difference between total-hardness and calcium-hardness results).

Bristol Bulletin

The Bristol Company has just published a 32 page bulletin on its "Series 500" line of recording gauges. Complete information is given on pressure gauges for ranges from 0 to 2 inches of water to 0 to 10,000 psi, vacuum gauges, low range draft and pressure gauges, barometers, and absolute pressure gauges for ranges as low as 0 to 6 mm. of mercury absolute. Measuring elements, operating principles, recording charts and accessories for the various types of recording gauges are fully described. Information is also included on Bristol instruments for automatic controlling and telemetering of pressure and vacuum values. In addition to numerous photographs, the bulletin is liberally illustrated with reproductions of actual chart records and sketches of applications of the instruments.

Onan Folder

A new folder which tells how any business, factory, institution, farm or home can be protected against property damage, production losses and danger to human life which are the frequent results of electric power failures has been issued by D. W. Onan & Sons, Inc.

A full page of illustrations shows a number of institutions and business establishments which are protected by Onan Standby installations. A short description of the power plants available from Onan is also included in the folder.

Truarc Catalog

An eight page catalog which completely describes the line of Waldes Truarc retaining rings has recently been issued by Waldes Kohinoor Corp. In the publication, rings are grouped according to basic use and data are given for each ring together with 42 drawings of typical cost-saving applications. New special type rings, assembly tools, fixtures and application pliers are also shown.

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We make our own basic electric steel—our forgesmiths are long-time experts in crankshaft forging—the heat treatment is handled in deep vertical furnaces—and our special machine tool equipment, manned by skilled craftsmen, assures adherence to close tolerance specifications.

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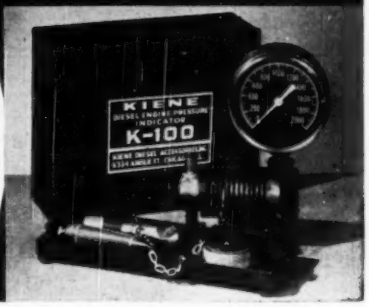

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Bureau of Standards

A new law has been passed by the Congress and signed by the President of the United States defining and describing the authorized functions and activities of the National Bureau of Standards. This law makes clear and explicit the legal basis for the activities of the National Bureau of Standards. The law is primarily an amendment to Section 2 of the Act of March 3, 1901, which established the Bureau.

The primary purposes for which the Bureau was established were to provide a basis for accurate measurements in this country and a source of information regarding basic properties of materials determined by such measurements. However, there arose almost immediately occasions for the practical application of these primary services to meet needs of the Government and of industry which were not foreseen, or at least not explicitly mentioned, in the Act. Consequently within a few years, the Congress made specific appropriations for activities which could only be covered by a broad interpretation of the clause, "the solution of problems which arise in connection with standards."

By another act, the 81st Congress has given formal statutory sanction to a revision of the practical system of electrical units. In large part, the values adopted for these units resulted from research by the National Bureau of Standards, and the present legislation was proposed by the Bureau. The changes in magnitude of the units are small, in no case larger than 1/20th of one per cent, but the new law puts the values on a clear and unambiguous basis which assures the closest practicable agreement between electrical and mechanical units.

The law previously in effect, enacted 56 years ago, included double definitions of the units. There were no central standards laboratories at that time, and to enable any competent laboratory to set up valid electrical standards, the United States law, as well as international agreements, prescribed certain devices to produce three basic units. The ampere was defined by the rate of deposition of silver in a voltameter or coulometer, the ohm as the resistance of a specified column of mercury, and the volt as a specified fraction of the electromotive force of a certain type of standard cell. It was later found that these conventional standards did not produce exactly the intended values of the units.

Recognizing these changed conditions, the American Institute of Electrical Engineers in 1928 proposed a return to the basic "absolute" units. Twenty years of research and negotiation were required to bring about unanimous international action to this end, in which the National Bureau of Standards played a leading role. The story of the accomplishment is told in detail in NBS Circular 475, "Establishment and Maintenance of the Electrical Units" (Superintendent of Documents, Government Printing Office, Washington 25, D.C., 25 cents per copy).

Field Notes

Cummins Racer Sets Record

Decisively smashing all existing world speed records for diesel-powered cars, Jimmy Jackson piloted the Cummins Diesel Special No. 61 to six new international marks, officially supervised by the contest board of the American Automobile Association, on Utah's Bonneville Salt Flats on September 11.

A new one-mile record of 165.23 mph. and one-kilometer mark of 163.82 mph. replace the former marks of 158.87 and 159.10 set several years ago by Capt. George Eyston, England's noted speed king. The new five mile record of 161.92 and five-kilometer speed of 164.25 upset those of 112.07 and 126.990 set in 1934 by "Wild Bill" Cummings at Daytona Beach, Fla. Jackson's 10-mile record was 148.14 and his 10-kilometer mark 147.63. No official international records previously existed for these distances.

The car is the same one that attracted widespread attention in the 1950 Memorial Day 500-mile speed classic at Indinapolis when it qualified at 129.208 mph., subsequently going out of the race at 130 miles due to an accessory part failure. It was powered for the Bonneville tests with regular stock Mobilfuel diesel fuel and lubricated with stock Delvac oil. The only change made for the runs was the addition of a hood over the driver's seat to enhance streamlining.

NLGI Meeting

The annual meeting of the National Lubricating Grease Institute will be held at the Edgewater Beach Hotel, Chicago, October 30, 31 and November 1. Registration cards have been distributed to allow those interested in attending the meeting to secure advance registrations. Cards can be secured from the NLGI, 4638 J. C. Nichols P'kwy., Kansas City 2, Mo.

New Firm

A new production firm, Ardec, Inc., with plant and general offices in Media, Pa., will specialize in the production of precision parts and assemblies for the diesel engine, automotive, electronic, aircraft and allied industries. It plans also to undertake special engineering and research projects including the production of prototype and testing units.

William A. Arnken, elected president, served the Baldwin Locomotive Works between 1928 and 1945 as supervisory engineer in the diesel engineering division and as supervisory analyst of all precision parts purchasing.

Arnken was chief engineer for American Precision Products Corporation from 1945 to 1948. The new firm is already engaged in work for several large companies in the Philadelphia area.

National Electric Sales Region

National Electric Products Corp. has created within its sales organization a western region and has named R. Graham Holabird the regional manager. The regional office is at 400 Potrero St., San Francisco. In making this sales territorial change, R. C. Bennett, Jr., vice president and sales manager, said the region was established to give customers a faster and more consolidated service.

Mr. Holabird has been with National Electric since 1931. He covered the Los Angeles territory until 1943, when he became manager of the company's San Francisco sales office. The new western regional manager has been affiliated with the Electrical Development League of southern California, the Northern California Electrical Bureau, the Electric Club of San Francisco, the Chamber of Commerce of San Francisco, and the American Legion.

Cat Subsidiary

Announcement of the formation of Caterpillar Tractor Co., Ltd., a wholly owned British subsidiary, was made recently by Louis B. Newmiller, president of Caterpillar Tractor Co. The new company will engage in the business of procuring, inspecting, storing and shipping British-made genuine "Caterpillar" parts to the company's dealers in United Kingdom and other countries. Employment at the newly-formed English branch will approximate 125 people, most of whom will be drawn from the vicinity of the British plant.

The plant will be primarily concerned with the wholesale distribution of parts made by selected British manufacturers and sold through authorized "Caterpillar" dealers. Some of the administrative employees of the

new company will, however, also have duties in connection with the foreign interests of Caterpillar Tractor Co., of Peoria, Illinois.

Deluxe Products Sale

James S. Allan, President of Walker Manufacturing Company of Wisconsin, Racine, Wisconsin, and The Deluxe Products Corporation, LaPorte, Indiana, announced recently that the machinery, tools, patterns, and equipment of the Deluxe Products Piston Division have been sold to The Ohio Piston Company, Cleveland, Ohio.

Dan P. Shaw, Vice President of The Ohio Piston Company, Cleveland, states that the machinery and equipment of the Deluxe Products Piston Division will be shipped to Cleveland and consolidated with the existing facilities at the Ohio Piston plant, 5340 Hamilton Avenue, Cleveland 14, Ohio. The added machinery will increase Ohio Piston's capacity approximately twenty-five per cent.

The Ohio Piston Company supplies pistons to the manufacturers of automotive, aircraft, industrial, marine, and tractor gas and diesel engines, as well as pistons for air and refrigeration compressors.

Socony Well

The Socony-Vacuum Oil Company, Inc., has announced completion of its first successful well in Canada. Located on a 7700-acre block 50 miles southeast of Edmonton in Alberta province, and 42 miles southeast of the Leduc-Woodbend Field, the well taps 29 ft. of oil-bearing Devonian limestone at a depth of 4507 ft. in the D-2 zone.

Successive drill-stem tests with a half-inch choke on separate portions of the 29-ft. pay section showed estimated daily rates of 700 barrels, 200 barrels, and 575 barrels.

The well has been designated Socony-Vacuum Flint No. 1. Its oil is sweet and with 33.3 gravity and a 500-to-one gas-oil ratio.

Before development of Socony-Vacuum Flint No. 1, the company completed nine unsuccessful drillings in Alberta, where it has a four and a half million acres under lease. The successful well was started in July, and other drilling operations are under way by Socony-Vacuum in Alberta province.

Diesel Plant Conferences

The University of Missouri and Oklahoma A & M will hold conferences for operators, engineers and superintendents of diesel power plants this month. The conference at Missouri is under the direction of Prof. R. T. Quick and will be held for four days beginning October 16th. The Oklahoma meeting will take place October 23, 24 and 25 and will be supervised by Prof. W. H. Easton.

The conference at Missouri will feature discussions on combustion and injection problems, bearing failures, pistons and rings, engine silencing, crankcase explosions and preventive maintenance led by experts from the diesel industry. The fourth day will be devoted to governor servicing. All

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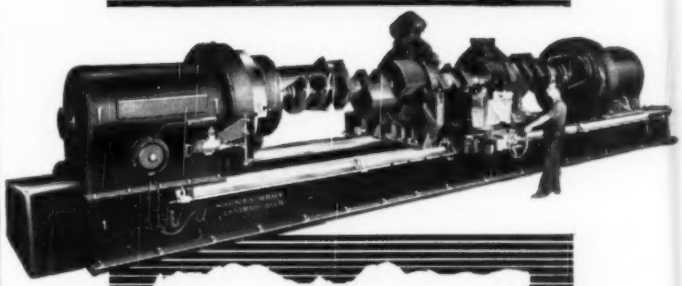

Higher production and greater flexibility accompany the Wickes Universal Crankshaft Lathe, designed to machine crankpins and line bearings on all sizes and types of crankshafts. Savings in time up to 400% have been made by machining in this lathe as compared to the time of machining in an engine lathe. Wickes Universal Crankshaft Lathes are equipped with single or double end drive, indexing and stroke setting pot chucks, 3-station turret and a back roller rest. If you have a crankshaft turning problem, call on us for time studies and proposals on the most suitable equipment.

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sessions will be concerned with the practical aspects of operation and maintenance. The conference is part of the new engineering extension program offered by the University College of Engineering through the Adult Education and Extension Service.

The Oklahoma conference will devote the first day to registration, fundamentals of power production in a diesel, indicators and indicator cards, fuel injection systems and problems, and dual-fuel and gas diesel engines. The second day will cover governors, pistons and piston rings and cooling systems, and the last day of the meeting will be devoted to recognition of different types of bearing failures, crankcase explosions and a panel discussion on trouble shooting.

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Five Millionth Liner

The 5,000,000th cylinder liner recently came off the production lines of Campbell, Wyant and Cannon Foundry Co. All of these liners—an average of 1,000,000 per year—have been centrifugally cast in the No. 6 plant, which was opened in 1945 and which is probably the largest and most completely mechanized foundry in the world devoted exclusively to the production of cylinder liners and sleeves.

Campbell-Wyant and Cannon manufacture these liners and sleeves in all sizes, weighing from several pounds each (for outboard motor engines and other small internal combustion engines) up to several hundred pounds each (for marine diesel equipment, railroad locomotive engines and various other types of engines). They are made in a wide variety of specifications. The volume production has been attained through the use of a unique centrifugal casting process which was developed and pioneered by the company and which has since been adopted by many foundries throughout the world.

Reliance Buy

A controlling stock interest in the Commonwealth Electric Company, Ltd., of Welland, Ontario, has been purchased by The Reliance Electric & Engineering Company, according to a recent announcement by J. W. Corey, president of the latter concern which, as the third largest U. S. manufacturer of industrial electric motors, generators and engineered drives for industry, already owns and operates motor and accessory manufacturing plants in Cleveland and Ashtabula, Ohio.

The acquisition involved a cash transaction only, it is understood.

The manufacture of transformers and electric motors, both Commonwealth products, will be continued in the Welland plant, where currently about two hundred men are employed, it was indicated by Corey.

"In addition," he said, "we propose to expand operations in Welland just as rapidly as possible to permit the production there of Reliance V-S drives and a number of other specialized electric drives regularly supplied by Reliance to major industries of both Canada and the United States."

Gas Turbine Plants

Large-scale production of gas turbines, latest type of power plants for land, railroad, and marine use, has been started by the General Electric Company in Schenectady, N. Y. plant facilities now being equipped at a cost in excess of $4,000,000.

Glenn B. Warren, manager of the company's Turbine Divisions, announced that "accelerated production" has begun on the first few of more than 20 gas turbines scheduled to be

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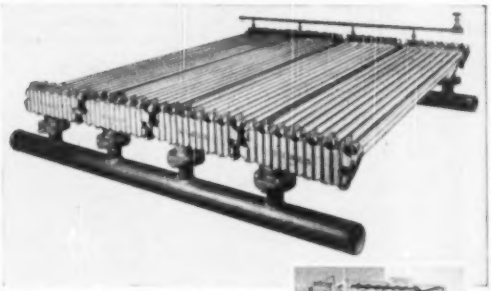
Slash Diesel "down time"



ABOVE: Binks Type "D" coils are strongly built with heavy 1-inch O. D. copper tubes, rolled into place in cast iron headers and flared down into a finished seat.

RIGHT: Binks cooling towers, used in conjunction with Binks heat exchange coils, simplify the maintenance of uniform jacket water temperatures and hence increase engine efficiency.

Type "D" evaporative heat exchange coils for closed-type Diesel cooling systems

- **Reduce Diesel breakdowns**
- **Eliminate scale**
- **Lower breakdown insurance rates**
- **Permit higher, controlled operating temperatures**
- **Give high cooling efficiency**
- **Permit high fluid velocity with minimum friction**

Binks Type "D" heat exchange coils bring new economies...new security to operators of Diesel engines. Now you can economically use soft or treated jacket water. Scale formation is eliminated. "Down time," caused by such engine troubles as overheating, lowered operating efficiency and breakdown, is reduced to a minimum.

Write today for your free copy of the new Bulletin 41.

This interesting bulletin tells the full story of Binks Type "D" evaporative heat exchange coils...tells how you can benefit from new economies through their use. Complete with drawings, photographs, and tables.

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6. Large stock of spare parts on hand.

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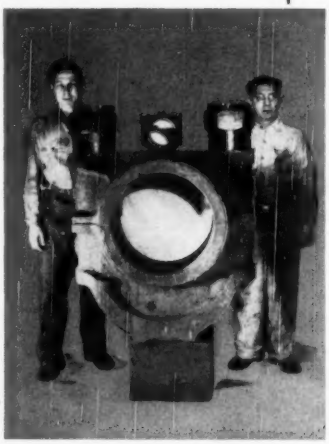

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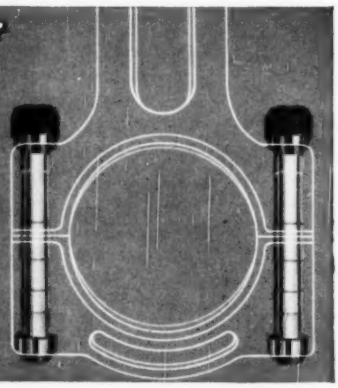

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built within the next two years for power generation and for gas pipeline pumping stations.

"Technological advances during the last twelve years and the successful operation of units now installed indicate the gas turbine is ready to assume a significant role in the power field, along with steam and mercury power plants," Warren said.

"Further advances," he said, "will find the gas turbine an effective tool, when properly applied, for still further reducing the cost of power."

Organizational News

George J. Rathbun

It is with extreme regret that we announce the recent death of George J. Rathbun, president of the Rathbun-Jones Engineering Co. After 54 years of association with the gas and diesel engine industry, it is fitting that he be honored not only for the fine gentleman he was but for his many contributions to his chosen field.

Details of Mr. Rathbun's professional career are practically a history of the diesel industry. He was born in Springfield, Mass. on June 24, 1871. His graduation from Cornell with a degree in Mechanical Engineering occurred in 1895, coincident with Dr. Diesel's early experiments. The following year in Toledo, he became an

PUT THIS New Low Cost IMO ON YOUR OIL LINES!

Now you can have all the advantages of the IMO: high speed operation—quietness—freedom from vibration—simplicity—reliability—at less cost than ever before.

Look at the cross-section and you will see why no other pump is quite so well suited for oil handling service.

The axial flow design permits oil to be pumped close to the rotating axis of the rotors. This means low liquid velocity and quiet operation at high speeds.

Large inlet areas provide smooth entrance of liquid into the pump and permit the handling of high viscosities at high suction lifts.

The A313A IMO has no stuffing boxes to leak or require packing, and best of all, it can be mounted in any position and be directly connected for operation at motor speeds.

For your next oil handling job, be sure of the best . . . specify the new low cost A313A IMO pump. Write for Bulletin I-161R-DP.

IMO-DE LAVAL PRODUCTS DIVISION
DE LAVAL STEAM TURBINE CO.,
TRENTON, NEW JERSEY

ELECTRIC
TACHOMETERS
Simplified RUGGED Design

HAND MODEL
Small size and light weight—ideal for any shop and production test application. Precision made, sealed ball bearings, and the elimination of wearing parts assure constant accuracy. Models from 0—2,400 RPM + 800 FPM, 5,000, 15,000, and 25,000 RPM. $40.00 and up.

PORTABLE MODEL
Measures any rotating speed with sustained accuracy for production and laboratory use. Three-range expanded scale: 0 to 1,000; 1,000 to 2,500; 2,500 to 5,000 and other models up to 20,000 RPM. Stability assured with no contacts, brushes or batteries to wear out. Accuracy ½, 1 or 2% of full scale. $67.50 and up.

MOUNTED MODEL
Non-directional or indicating forward or reverse speeds in any required range up to 25,000 RPM. Available with SAE fittings and base mount. Calibrated to your exact needs. Completely enclosed and protected against moisture and dirt. $56.00 and up.

Special models made for any specific requirements

ELECTRO-MECHANO CO.
264 E. Erie St., Milwaukee, Wis.

engineer with the S. M. Jones Company. The firm was then producing a single cylinder horizontal gas engine for oil field use.

By 1909 the sale of gas engines was encouraging enough to warrant the incorporation of Rathbun-Jones Engineering Company for the purpose of building these engines. Mr. Rathbun held a variety of offices until 1918 when he became president of the firm.

Under the guidance of Mr. Rathbun the line of gas and diesel engines was continually improved with the present line of box frame engines appearing in 1930. During the recent war, the firm was engaged in building engines that could be operated either as gas or diesel engines by changing the cylinder heads and making certain changes in the fuel system. The natural outgrowth of this work was the dual-fuel engine, experiments on which started in June 1944. This makes Rathbun-Jones one of the first organizations in this country to develop this type of engine.

Mr. Rathbun was active in the firm until his death. The organization will continue with Mr. Edward Rathbun as the new president.

Lee Lyles

Lee Lyles, Assistant to President, Santa Fe Railway, died July 21 after an extended illness. Born at Cameron, Texas, August 18, 1893, Lyles entered Santa Fe service as a stenographer and clerk in April, 1911, in the operating department in Texas. He served in various positions in the freight traffic and law departments until 1930 when he was transferred to the Executive Offices in New York City. Five years later he was appointed Assistant to President, Chicago, and was placed in charge of the newly organized Public Relations Department, June 1, 1936 which position he held at the time of his death.

A member of the Advisory Committee on Public Relations of the Association of American Railroads and also a Director of the Public Relations Society of America, he was a member of the Chicago Athletic Association, Variety Club, Masons and Elks.

Baldwin Promotions

Several changes have been announced recently by the Baldwin Locomotive Works.

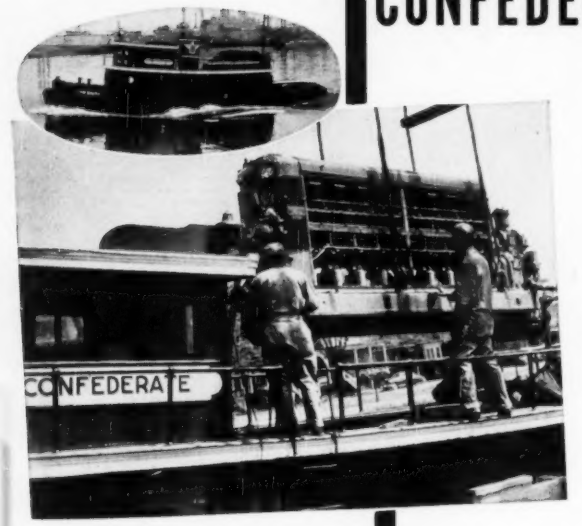
George F. Walsh has been appointed sales promotion manager; Robert S. Oberlander has been appointed Diesel Engine Department Manager and E. F. Sheehan is the new appointee to the position of manager, Renewal Parts Department.

Mr. Walsh was the sales promotion manager for Baldwin when he received his latest promotion. Prior to joining Baldwin in 1948, he was employed by Willard G. Meyers Advertising Agency in Philadelphia and the Electric Storage Battery Company.

Mr. Oberlander joined the Baldwin organization in 1940 and, after 2½ years in the machine shops was transferred to the diesel engine sales department at the main office in Eddystone, Pa. He was named acting sales manager of the Eddystone group in 1947, which position he held at the time of his recent appointment.

Mr. Sheehan joined the Baldwin organization in 1939 and served suc-

CONFEDERATE COME-BACK!



60 ft. tug **CONFEDERATE**, *23 years young. Owned and operated by Lynch Brothers Towing Co., Norfolk, Va. Re-engined by Lister-Blackstone.*

PROFITS LAID ON THE LINE! *New, 8-cyl., 320 hp. Lister-Blackstone Model EPVMDR-8 about to be lowered onto engine bed of* **CONFEDERATE**.

P.S. — The 8 hp. auxiliary is a Lister-Blackstone, too — naturally.

Specify PROFITS *in Advance*

For real profit 'gravy' investigate the engine—investigate the engineering—that enable newly re-engined, 23-years-*young* CONFEDERATE to add an *extra* round trip every week to those on her former oil-tow schedule between Norfolk and Richmond, Va. Write us for the full story, regardless of the type of diesel you require!

LOW PRICES!

3 to 480 hp. Service and parts from Lister-Blackstone distributors everywhere. Write us your requirements. Address Dept. T.

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Parts Warehouses:
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Boston • New York • Norfolk • New Orleans • Mobile
Tampa • Miami • Jacksonville • San Antonio • Dallas • Houston
Newton (Iowa) • Seattle • Los Angeles • San Francisco • San Diego
Montreal • Toronto • Winnipeg • Vancouver
Sold and Serviced in 37 Countries Throughout The World

Lister-Blackstone

cessively as assistant Works Manager, assistant to Vice President-Operations, co-ordinator of Purchases and Stores, and assistant manager, Renewal Parts Department.

DEMA Educational Director

Robert L. Stanley will join the staff of the Diesel Engine Manufacturers Association on October 1 as Educational Director.

Professor Stanley comes to this position from the Pennsylvania State College where he has been working in diesel engine research in the Engineering Experiment Station. Both Professor Stanley and the diesel activities of the Pennsylvania State College are well known throughout mechanical engineering circles, which means he will be welcomed by educators in the diesel engineering field. DEMA's educational program is pointed toward helping those professors who are teaching diesel engine courses in the 120 accredited mechanical engineering schools of the country do a better job.

Robert L. Stanley

Prior to Professor Stanley joining the teaching staff at the Pennsylvania State College, he was at Union College, Schenectady, New York. He is a graduate of both Ohio State and Rutgers Universities.

Sperry Plant Manager

George Demougeot has been appointed plant manager of Sperry Products, Inc., Danbury, Connecticut, according to J. B. Farwell, president.

Mr. Demougeot was formerly plant manager of the Ronson Art Metal Works, Inc., Watson Flagg and Fairchild Engine & Airplane Corp. He was also director of manufacturing for the latter organization. He has also been associated with Bendix Aviation Corp., and Carrier Corp.

Mr. Demougeot is a graduate of Columbia University, a member of the American Society of Mechanical Engineers and the Society for the Advancement of Management.

Graver Representative

Graver Water Conditioning Co. announces the appointment of James T.

HAVE YOU A JOB FOR A TRAINED MECHANIC?

We have a number of alert young men who have completed intensive training in Diesel Mechanics. They learned their trades thoroughly by working on actual equipment under personal, expert supervision. If you need a trained man, we invite you to write for an outline of our course, and for a prospectus of the graduate. No fees, of course. Address:

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AC Generators: 6¼ to 1000 KVA
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Write for information. Our Engineers will be glad to review your requirements.

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from every angle
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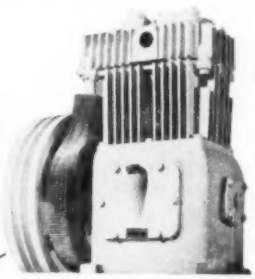
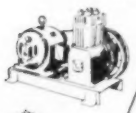


but the inside story of **Quincy** COMPRESSORS is even better!



Quincy Compressors not only look good as a part of a Diesel installation, they have an established reputation for dependability. Special design features for greater dependability and durability include — Timken bearings — Lynite rods — perfectly balanced crankshaft — copperfinned intercooler — automatic and positive lubrication. Available in a wide variety of sizes ranging from 1 to 90 c.f.m. Depend on a Quincy specialist to help you select the correct type and size compressor to meet your requirements. Write Dept. J-13 for details and prices.

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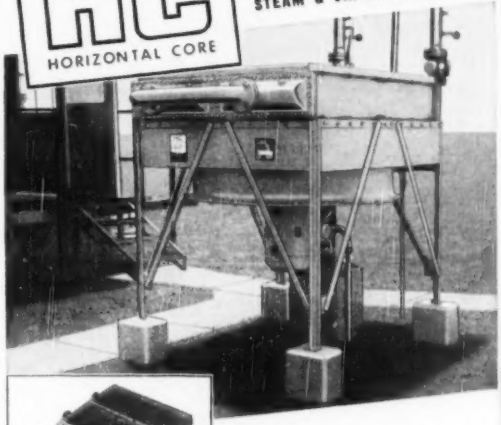
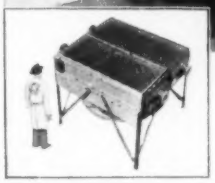
QUINCY, ILLINOIS Branch Offices: New York • Philadelphia • Chicago • St. Louis • Dallas • San Francisco
Manufacturers of Air Compressors Exclusively

YOUNG "HC" HORIZONTAL CORE

ECONOMY PLUS VERSATILITY IN
WATER, OIL, GAS COOLING . . .
STEAM & VAPOR CONDENSING





Basic "HC" Unit may be used in multiples for greater cooling capacity or combination of services.

IMPORTANT FACTS ABOUT THE "HC"

- LOW COST—small initial investment, economical maintenance.
- VERTICAL AIR DISCHARGE—eliminates cross wind effects.
- HIGHLY EFFICIENT—airfoil section fan.
- MULTIPLE INSTALLATIONS—provide greater capacity, combined services.
- NO VIBRATION—adjustable pitch fan mounted separately from unit.
- LARGE CAPACITY—water cooling, from 600,000 Btu/hr up; oil cooling, from 20,000 Btu/hr up.
- LOW HP REQUIREMENT—1 to 10 hp per fan.
- EASY INSTALLATION—simplified piping and frame construction.
- CORE GUARD SCREEN—protects cores from falling objects.

• Here is another development by Young providing high efficiency cooling and condensing at low initial and operating costs. The Dual coil "HC" is designed for water and lube oil cooling. Manifolds are available for all types of coils. Four sizes, with 2, 4, 6 and 8 coil installations, provide exceptional versatility in heat transfer service. The 4 or 6 blade fan, serving each two coil unit, may be mounted directly on the fan motor shaft, or powered by a v-belt or gear speed reducer drive. Full details about the new "HC" Units, or other Young Heat Transfer Products, are available on request.

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OIL FIELD, HEAVY INDUSTRIAL, MUNICIPAL & CHEMICAL PROCESS COOLING EQUIPMENT
Engine jacket water coolers • Oil coolers • Steam and natural gas condensers • Natural gas coolers • Evaporative coolers and condensers • "VAD" Vertical air discharge cooling and condensing units

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Gas, gasoline, Diesel engine cooling radiators • Heat exchangers • Intercoolers • Oil coolers • Supercharger intercoolers

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for Low-Cost Experimental or Production Runs of Precision

Camshafts

- Rigid adherence to specifications gives you lower installation costs.
- Complete facilities for *Tocco* hardening.
- Over 40 years experience will help in your development problems.

Facilities also available for production of steering spindle and arm assemblies, spindles, spring hangers, etc.

For complete information about Muskegon Crankshafts and Camshafts, write

MUSKEGON MOTOR SPECIALTIES COMPANY

JACKSON, MICHIGAN

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Potter as its representative for the states of North and South Carolina.

Mr. Potter has specialized in the field of water treatment for more than 20 years since he completed his studies in Industrial Chemistry at the University of Kentucky and Chemical Engineering at the University of Alabama. Throughout that time he has familiarized himself with the special conditions and requirements of the Southeast.

Mr. Potter's headquarters are at 1521 Stanford Place, Charlotte, North Carolina.

Nickel Cadmium Battery Representatives

Three new representatives have been appointed by the Nickel Cadmium Battery Corporation for the sale of nickel cadmium batteries.

B. C. MacDonald and Company, Arcade Building, St. Louis 1, Missouri has been appointed railway sales representative for Nicad diesel starting batteries.

Gordon H. Proffitt with offices in the Matson Building, 215 Market St., San Francisco 5, has been appointed sales representative for the firm to serve markets for the batteries including diesel locomotive starting, marine, utility and highway truck and bus services.

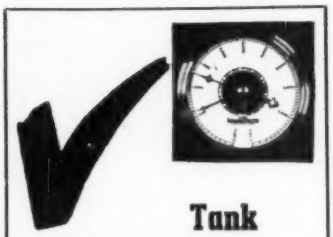
The Frank B. Nugent Co. of 710 Pioneer Building, St. Paul 1, Minnesota, will represent the firm in the sale of *Nicad* batteries specializing in batteries for diesel locomotive starting.

Nickel cadmium storage batteries have been widely applied to many services in Europe for more than 40 years. Since the end of World War II, they have been manufactured and distributed in this country and are rapidly being adopted in many services where long life and high current rates are prime considerations.

Dearborn Representatives

Dearborn Chemical Company, manufacturers of boiler feed water treatment and *No-Ox-Id* rust preventives, has announced the addition of twelve new representatives to their sales and service staff. These men recently completed an intensive seven week training course conducted in Dearborn's Chicago offices and laboratories and have been assigned to territories as indicated:

T. Armstrong: West Texas and New Mexico with headquarters in Amarillo; R. W. Bartlett: New England with headquarters in Boston; C. P. Blakeley: New Jersey with headquarters in New York City; T. Bull: Northern California with headquarters in San



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With Liquidometer remote reading fuel storage tank gauges you can check quickly and accurately oil deliveries, consumption and amount on hand. No Diesel plant is complete without one. Liquidometer or Levelometer models are available for tanks of any capacity.

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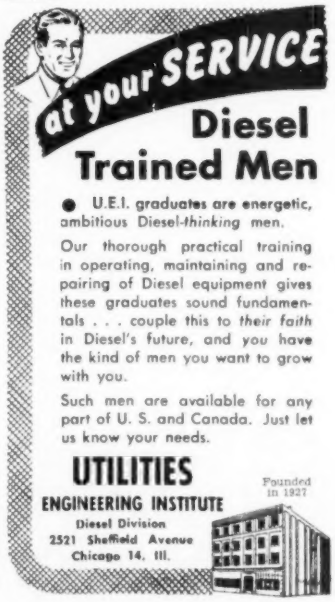
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Diesel Trained Men
● U.E.I. graduates are energetic, ambitious Diesel-*thinking* men.
Our thorough practical training in operating, maintaining and repairing of Diesel equipment gives these graduates sound fundamentals . . . couple this to *their faith* in Diesel's future, and *you* have the kind of men you want to grow with you.
Such men are available for any part of U. S. and Canada. Just let us know your needs.
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EXPEDITE OVERHAUL

with specialized Oakite cleaning compounds & methods

IF you are looking for practical ways and means to speed up Diesel overhaul—clean parts the fast, money-saving Oakite way—you'll be ahead of schedule.

Oakite cleaning materials are deliberately designed to remove heaviest accumulations of sludge, oil, scale. They are so thorough in their detergent action and so quick-acting, that inspection of parts preceding Diesel repair or overhaul is simplified, made more certain. Your mechanics can see at a glance what needs to be done—waste no time doing it!

For complete story on Oakite before-repair cleaning of Diesels write address below. We shall be glad to send it to you, without cost or obligation, of course.

Get FREE Manual

Free manual describes many other maintenance cleaning jobs. Contains interesting information on simplified ways to remove scale, rust, etc. Send for your copy today. *No obligation.*

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SPECIALIZED INDUSTRIAL CLEANING
MATERIALS • METHODS • SERVICE

Francisco; J. W. Fisher: Eastern Ohio with headquarters in Cleveland; R. E. Johnson: Northern part of the city of Chicago; W. J. Mercier: Southern Wisconsin with headquarters in Milwaukee; R. T. Moran: part of Michigan with headquarters in Kalamazoo; D. E. Pedginse: Northern Indiana with headquarters in South Bend; H. O. Scott: Central Ohio with headquarters in Dayton.

Two men have also been added to Dearborn's technical department in the Chicago office. V. P. Nobile will assist E. M. Welch, manager of Dearborn's Industrial Water Treatment Department and K. W. Franks will assist J. F. Wilkes, Technical Director of Dearborn's Railroad Department.

Weston Changes

Earl Melen, president of Weston Electrical Instrument Corp. has announced the appointment of Philip Barnes as general sales manager and Charles B. Denton as advertising manager.

Mr. Barnes has been associated with the Weston organization for 16 years. During World War II he served as a lieutenant in the U. S. Navy, and following his return from active duty he was appointed advertising manager.

Mr. Denton joined the Weston organization in 1925 and was associated with the company's advertising and sales promotional activities until 1942. During the war he directed the activities of Weston's labor-management war production drive committee and functioned as public relations manager.

Worthington Changes

H. C. Ramsey, President of Worthington Pump and Machinery Corporation has announced that Walther H. Feldman who has resigned as president of the corporation's subsidiary company, Electric Machinery Mfg. Company of Minneapolis, has been named Vice President in charge of Sales for Worthington, effective May 1. On the same date, John J. Summersby became Vice President in charge of Purchases; Frederic W. Thomas became General Manager of Purchases; and Carleton Reynell, General Representative, Sales and Purchasing Departments.

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Crankshafts

V Rigid adherence to specifications gives you lower installation costs.

V Complete facilities for Tocco hardening.

V Over 40 years experience will help in your development problems.

Facilities also available for production of steering spindle and arm assemblies, spindles, spring hangers, etc.

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American Bosch
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There's a reason why we've grown—since 1904—to be the automotive and Diesel leaders in this busy New England area. A recognized service organization geared for fast, intelligent handling of your specialized maintenance problems.

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For Research and Maintenance Studies of . . .

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The Electro Pressuregraph Syncro-Marker offers unequalled versatility and accuracy in solving research and maintenance problems. It provides a detailed picture of the firing of regular and instantaneous pressure variations. Measures pressure rise with time, from vacuum to 14,000 P.S.I. Only a threaded hole in region where pressure is to be checked is required for installation. Exclusive patented features. Proved in use by known firms.

COMPRESSORS INTERNAL COMBUSTION ENGINES

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ELECTRO PRODUCTS LABORATORIES, Inc. 4505-PM Ravenswood Ave., Chicago 40, Ill.

Nordberg District Manager

The appointment of Dice Cowger as District Manager of the Diesel Engine Department is announced by R. W. Bayerlein, vice-president, Heavy Machinery Division, Nordberg Manufacturing Company. Mr. Cowger has his headquarters at the Busch-Sulzer Bros. Diesel Engine Company, Division of Nordberg in St. Louis.

Prior to his joining Nordberg, Cowger was a member of the sales force of National Supply Company which he joined in 1947. From 1942 to 1945 he represented Busch-Sulzer Company in the New York office. From 1945 to 1947 he marketed and jobbed gasoline in St. Louis.

Mack Vice-President

Election of F. S. Nickerson as vice president of Mack-International Motor Truck Corporation and his appointment as manager of the company's Central Division Sales territory is announced by A. F. Fenner, vice president and general sales manager for Mack's Central, Southwest and Western Divisions. Active in the truck world since 1932, Mr. Nickerson joined Mack in 1945 as sales representative in its Atlantic Division. The following year he was appointed manager of the company's Baltimore (Md.) direct factory branch, a post he relinquishes to take up his new duties.

Mr. Nickerson will make his headquarters in Mack's Chicago office.

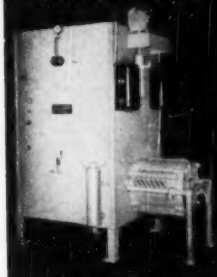
Fairbanks Changes

Mr. V. H. Peterson, Manager, Railroad Division, Fairbanks, Morse & Co., Chicago, has announced the following changes:

Mr. J. G. Graham who has, for the past several years, been with the Railroad Locomotive Division of the company with headquarters in Chicago, has now been appointed Eastern Regional Manager of Locomotive Sales. He will be located in New York City where he will have jurisdiction over the sales of locomotives in the New York, Southeastern and Cleveland areas.

Mr. D. C. Prescott who has for the past year been a representative of the

FOR CLEAN OIL and CLEAN ENGINES . . .



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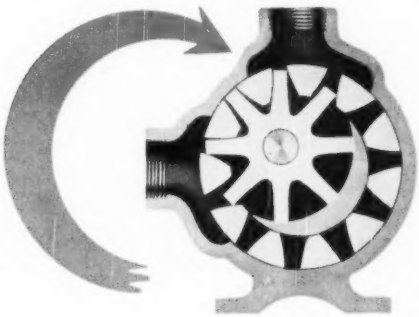
Locomotive Sales Staff in the Chicago district, has now been appointed District Manager—Locomotive Sales of the Southwestern district and will be located in St. Louis after October 1, 1950.

Mr. C. H. Morse, Jr., who has been, for the past year, Assistant Manager of Diesel Locomotive Service with headquarters at the Beloit, Wisconsin, Works, has been appointed District Manager — Locomotive Sales with headquarters in Chicago. He will have sales jurisdiction over the Chicago and St. Paul-Minneapolis areas.

Detroit Diesel Change

William Fox has been appointed Publicity Manager of the Detroit Diesel Engine Division of General Motors Corporation, according to an announcement made by J. W. Brown, Advertising Manager. In his new capacity, Fox will conduct field photographic tours and issue Product News Releases on diesel engines manufactured by the Detroit Division.

Fox joined Detroit Diesel in 1942 and has been in the Advertising Department since 1947. He attended the University of Michigan and has had extensive sales and advertising experience with Detroit manufacturers and advertising agencies.



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VIKING PUMP CO. Cedar Falls, Iowa

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TEXTILE TYPE HEAT EXCHANGERS

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JACKET WATER HEAT EXCHANGERS and EXHAUST GAS BOILERS for INTERNAL COMBUSTION ENGINES

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LUBE OIL COOLERS

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INSTANTANEOUS WATER HEATERS
STORAGE WATER HEATERS

•

DE-AERATING FEED WATER HEATERS

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THE SIMS CO • Box 1096B, Erie, Pa.

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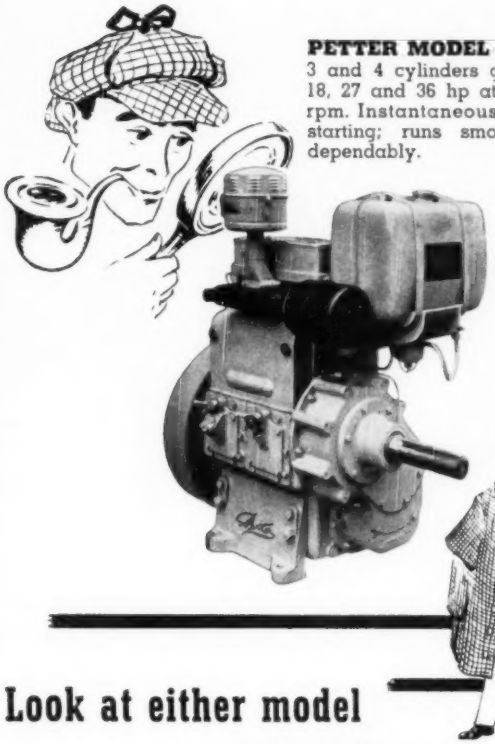

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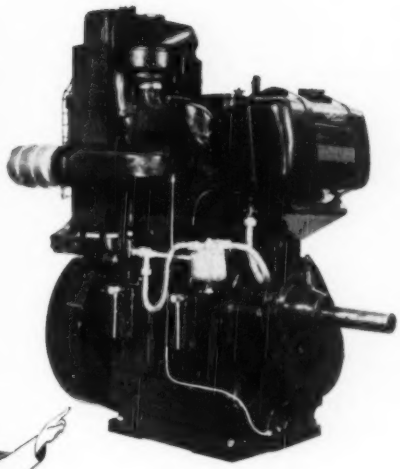

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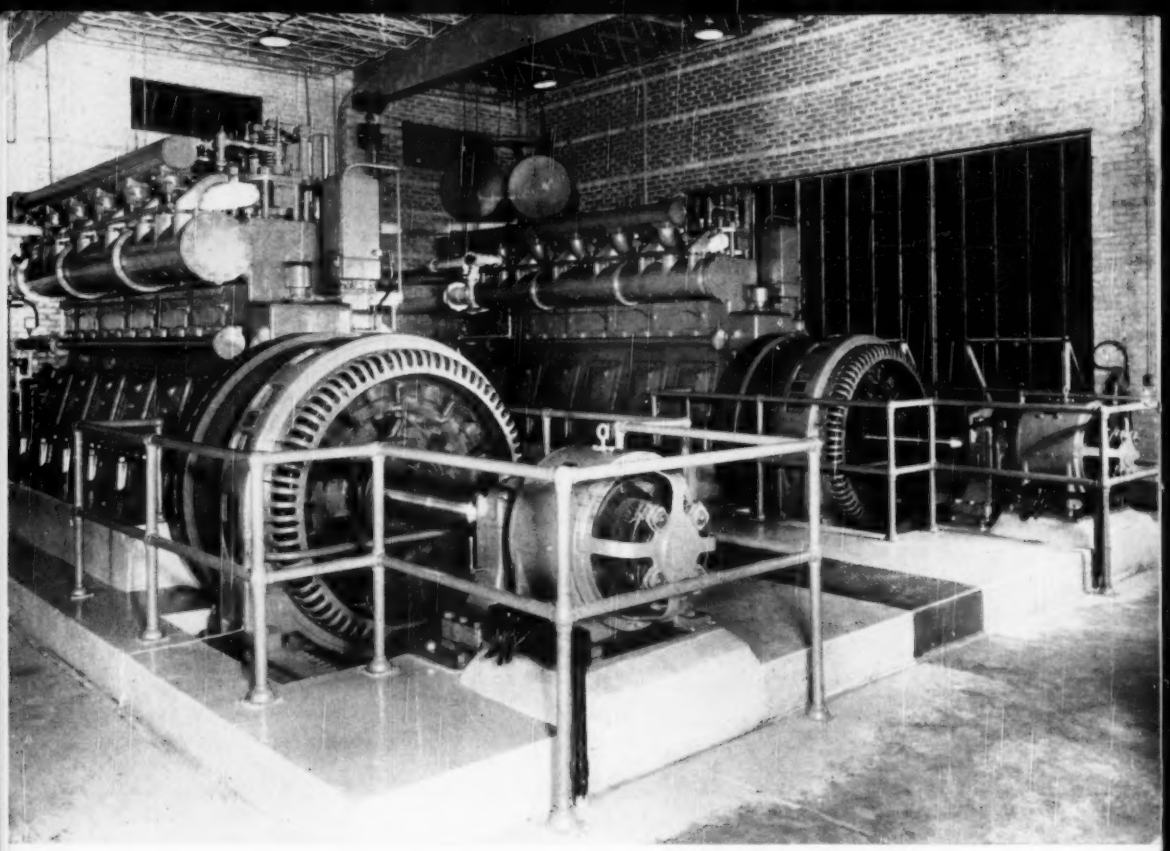

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